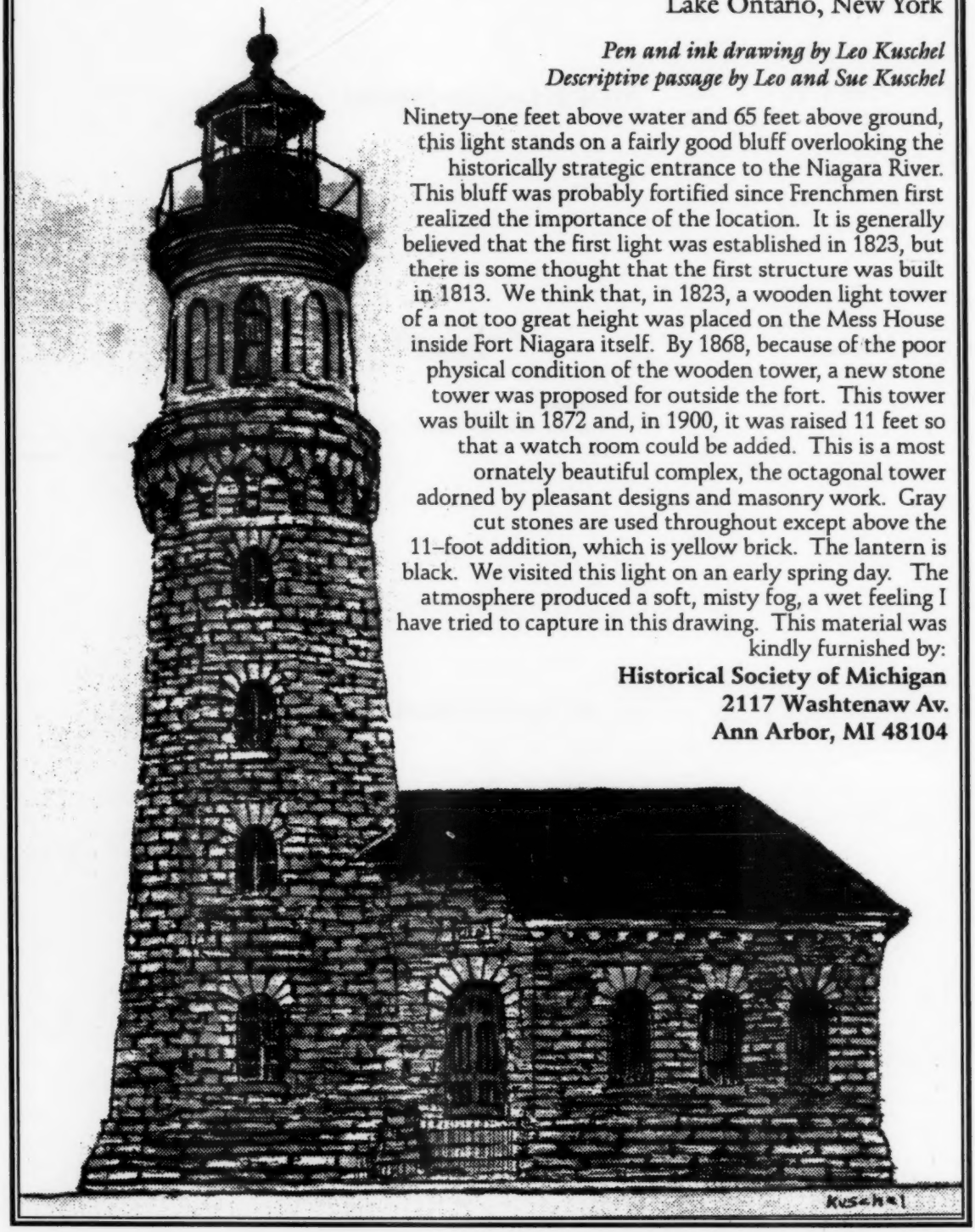
Mariners Weather Log

Spring 1990 Vol. 34, No. 2

Fort Niagara Light

Lake Ontario, New York

Pen and ink drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel



Ninety–one feet above water and 65 feet above ground, this light stands on a fairly good bluff overlooking the historically strategic entrance to the Niagara River. This bluff was probably fortified since Frenchmen first realized the importance of the location. It is generally believed that the first light was established in 1823, but there is some thought that the first structure was built in 1813. We think that, in 1823, a wooden light tower of a not too great height was placed on the Mess House inside Fort Niagara itself. By 1868, because of the poor physical condition of the wooden tower, a new stone tower was proposed for outside the fort. This tower was built in 1872 and, in 1900, it was raised 11 feet so that a watch room could be added. This is a most ornately beautiful complex, the octagonal tower adorned by pleasant designs and masonry work. Gray cut stones are used throughout except above the 11–foot addition, which is yellow brick. The lantern is black. We visited this light on an early spring day. The atmosphere produced a soft, misty fog, a wet feeling I have tried to capture in this drawing. This material was kindly furnished by:

Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104

Mariners Weather Log

Vol. 34, No. 2 April, May and June 1990

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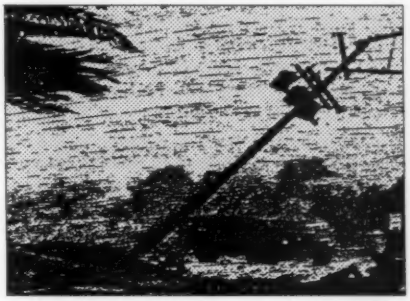

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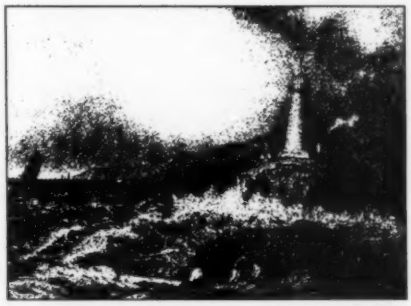

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Cover: Hurricane Hugo approaches the South Carolina coast on the 21st of September, soon to become the costliest storm in U.S. history. See page 12 for a review of all the hurricanes. Photo courtesy of John Shadid of NESDIS.

Back Cover: The 200th anniversary celebration of the U.S. Coast Guard continues. The ***Alexander Hamilton*** was one of at least seven vessels that made up the *Morris* class, which formed the backbone on the Revenue Cutter Service in the mid–nineteenth century. The Hamilton was wrecked in a gale off Charleston, SC in 1853. The drawings are based upon the research of the famous historian Howard I. Chapelle.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July 1, 1991.

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Hurricanes Haunt our History

Patrick Hughes
Editor, Weatherwise

Hurricanes have played an awesome role in the American panorama. They have touched the lives of Americans great and small and, at times, have changed the course of our destiny, as well as the shape of our coastline. There also have been hurricanes whose effects were felt on the shores of the Old World, as well as the New.

A version of this article appeared in *Weatherwise* in June 1987. It is a revised version of an article published in *American Weather Stories* and *Columbia Magazine*. Pat Hughes, Editor of Weatherwise, was one of NOAA's best writers before he retired.

The Old North Church steeple fell during Hurricane Carol in 1954. This was the church from which the famous "one if by land two if by sea" signal was displayed that set Paul Revere off on his famous ride. This steeple had been rebuilt in 1806 replacing the original, which was toppled by a hurricane in 1804. (Wide World Photo).

Christopher Columbus (right) was a weather–wise seaman. On his second voyage to the New World, he ran into a September tropical storm, which he survived by anchoring his fleet behind Saona Is. off Hispaniola. On his fourth voyage he put this knowledge to good use to save his vessel from a full–blown hurricane.

Library of Congress

Christopher Columbus was intimately acquainted with hurricanes, having encountered his first in June 1494. Arriving off Hispaniola on his fourth and final voyage in the summer of 1502, the aging Admiral, now fallen from favor, read the signs of an approaching storm. He requested the shelter of Santo Domingo harbor, but was refused. Instead, ignoring Columbus' warning, some 30 vessels, many loaded with gold and slaves, sailed proudly out of the harbor for Spain. Francisco de Bobadilla, Columbus' mortal enemy, sailed on the flagship.

Twenty ships and over 500 men, including de Bobadilla, were never seen again. Only one vessel reached Spain— a small leaky ship grudgingly assigned to carry back to Spain the proceeds from the sale of Columbus' few remaining Island properties, his guarantee of an independent old age.

Columbus himself, a weather–wise seaman, rode out the hurricane safely at anchor in an island cove. Meanwhile, Santo Domingo was smashed flat— for the first of many times.

In August 1508, Ponce de Leon encountered two hurricanes. The first drove his ship onto the rocks in the port of Yuna, Hispaniola; 13 days later, a second cyclone beached the same vessel on the southwest coast of Puerto Rico. Hernan Cortes, whose discovery of treasure focused the covetous gaze of Europe on the newly discovered lands to the west, lost the first vessel he sent to Mexico in a severe hurricane in October 1525. Captain Juan de Avalos (a relative of Cortes), two Franciscan friars and some 70 seamen drowned.

Many ships sailed from Havana; often only a handful reached Spain.

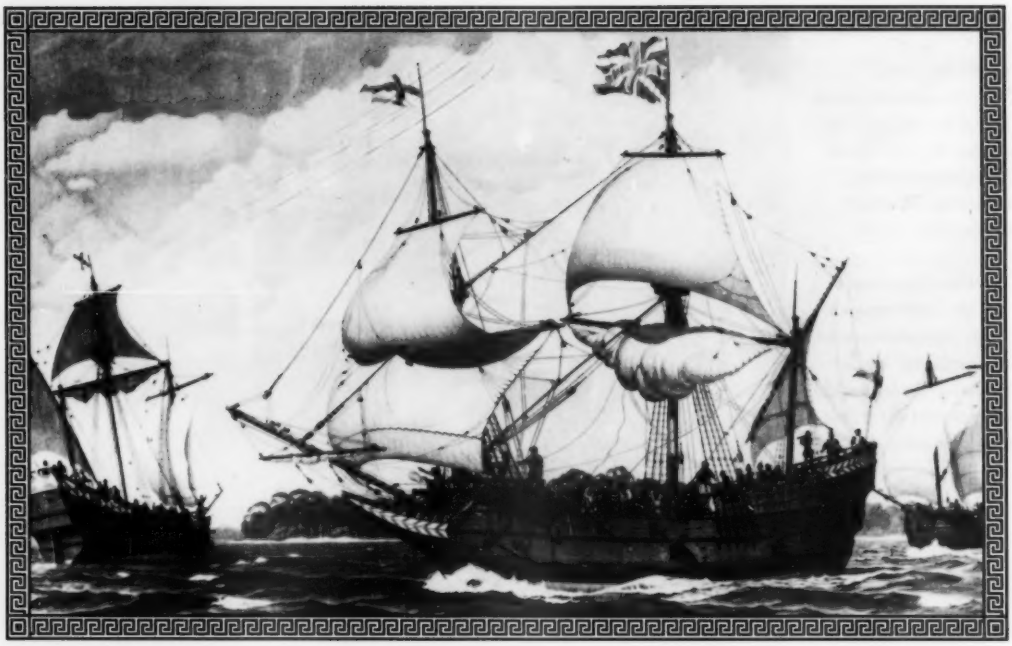
On September 22, 1565, a great hurricane scattered a French fleet and allowed the Spanish to capture the French's Fort Caroline, near the present site of Jacksonville, Florida. This ended France's bid to dominate the Atlantic Coast of the New World.

Meanwhile, annual treasure fleets were carrying the riches of the virgin continent back to the war–depleted coffers of Spain. Each year the fleet assembled in Havana, scheduled to sail for Spain in March. Each year fiestas, banquets and religious ceremonies stretched the departure date to August, and even to September, at the height of the hurricane season. Many ships sailed from Havana; often only a handful reached Spain. It is said that a ship was sunk for every lonely mile of the unexplored Florida coast.

In July 1609, a small fleet of ships crowded with settlers bound for the Virginia colonies was overwhelmed by a hurricane. One sank immediately; the others were scattered. All but one of the surviving vessels managed to limp into Jamestown.

The *Sea Adventure*, flagship of the fleet, was given up for lost. Ten months later, however, her passengers and crew arrived at Jamestown in a small boat built from the wreckage of the flagship. They had foundered on the rocks of Bermuda.

The voyagers had found Bermuda a natural paradise. An account of their adventure was published in London in 1612, intriguing an



"Now would I give a thousand furlongs of sea for an acre of barren ground — long heath, brown furze, any thing. The wills above be done, but I would fain die a dry death." —The Tempest by William Shakespeare.

Shakespeare's tale was based on the story of the survivors of the flagship of a small fleet of ships bound for the Virginia colonies. The fleet was savaged by a hurricane in 1609. The flagship foundered on the rocks of Bermuda.

English playwright. His interest in the tale led William Shakespeare to write his beautiful play, *The Tempest*— one of the happiest endings a hurricane ever had.

Bermuda itself got its name because of a hurricane. It was named after a Spaniard, Juan Bermudes, another hurricane shipwreck victim.

Throughout the long colonial period of American history, the predominantly low–lying coastal settlements were repeatedly raked by hurricanes. The terrible storms struck without warning, unroofing, flooding and washing away homes; destroying crops; tearing up great trees by their roots; sinking ships or stranding them in village streets, forests and cornfields. The cyclones often killed settlers, sailors and travelers by the hundreds, occasionally, by the thousands. They blew down great forest areas and made travel impossible for months, isolating stricken survivors, who often faced the threat of famine in the coming winter.

On the night of August 13, 1766, the tiny village of Trois–Islets, on the island of Martinique in the French West Indies, was crushed by a hurricane. Joseph–Gaspard Tascher, a wealthy planter, was wiped out by the storm, his family poverty–stricken. Later one of his daughters, Marie Josephine Rose, returned to France to seek her fortune. There she caught the fancy of an ambitious young army officer, whom she married.

If it hadn't been for that hurricane, Marie might well have spent her days on Martinique, a belle of island society. Instead she became the Empress Josephine of France when her husband, Napoleon Bonaparte, rose to power.

It was a hurricane that brought Alexander Hamilton into the pages of American history. His description, in a letter to his father, of a terrible storm that ravaged the island of St. Croix in the West Indies on August 3 and September 1, 1772, so impressed local planters that they took up a collection to send young Hamilton to King's College (now Columbia University) in New York. He was there in 1774 when the first rumblings of revolution were heard.

Only one of thirty vessels in Galveston Harbor held to its moorings...

In August 1778 a hurricane mauled and separated warships of British and French fleets maneuvering for battle south of Newport, Rhode Island. Two years later, a British fleet east of Daytona Beach, Florida, was savaged by an early October hurricane, then a few days later, struck by a second storm near Bermuda. Meanwhile, the first cyclone scattered and badly damaged a second British fleet off the Virginia Capes, then roared northward to strike yet another British squadron off Rhode Island.

It has been said that the final British surrender at Yorktown in October 1781 was at least partly due to the British Navy's reluctance to engage the French fleet blockading General Corn-

Empress Josephine

President McKinley

wallis during the dangerous fall hurricane season.

One of the most notorious hurricanes of the 19th Century demolished a fledgling American settlement on Galveston Island in the newly proclaimed Republic of Texas in early October 1837. According to an eyewitness, "... every house, camp, sod house, and inhabited structure was swept away, except the Old Mexican custom–house..." Only one of thirty vessels in Galveston Harbor held to its mooring; the rest were driven aground or blown out to sea. "Men, women, and children were seen floating upon boards, logs, and small boats, for days and nights, in every part of the island. Miraculously, only one life was lost." Unfortunately, the hurricane was far from finished.

Eight days later, the brand new paddle–wheel steamer, ***Home***, was beached and demolished just south of Cape Hatteras, North Carolina, by the same storm. There were only two life preservers on the ship. Forty of her 130 passengers struggled ashore to safety; the rest, mostly women and children, were drowned. Because of this disaster, Congress passed a law requiring all American vessels to carry a life preserver for each passenger— a law that has since saved many Americans from a watery grave.

On October 29, 1861, the Federal "Expedition," the largest fleet of American warships and transports yet assembled, sailed south from Chesapeake Bay to attack Confederate coastal installations. As the fleet rounded the Carolina Capes on November 2d, it was staggered by a hurricane that sank two vessels and scattered the rest. The fleet managed to regroup, however, and, on November 7th, captured Port Royal Sound, South Carolina.

When the ***Maine*** was sunk in Havana harbor in 1898, the United States declared war on Spain. Fearful for the safety of American naval units soon to be operating in hurricane waters, Willis L. Moore, Chief of the Weather Bureau, went to see President McKinley to urge the establishment of hurricane warning stations in the West Indies. Impressed by Moore's arguments, McKinley declared that he was more afraid of a hurricane than he was of the Spanish Navy. He ordered Moore to organize the warning system immediately.

... only to be completely demolished in the hurricane surf of October 2, 1898, immortalizing to this day the *Privy Hurricane.*

A battle fleet left Spain steaming westward. Concern spread along the east coast of the United States. Observation posts were hurriedly built at key points... emergency plans made— all for nothing. The Spanish fleet was trapped in the harbor at Santiago, Cuba, and destroyed. The war ended. Not a single hurricane had appeared ... no American ships or men had been lost. The hurricanes came late that year, or they might have played a role in the drama that marked the end of Spanish power in the New World— as they had at its beginning, four centuries before.

Those coastal lookout stations, built for a Spanish attack that never came, were abandoned by the Navy. A little later they were taken over by the Weather Bureau as hurricane observation posts. Upon inventory, the installation at Carolina Beach, North Carolina, was found to lack a most desirable piece of equipment— its privy had disappeared. Intensive investigation disclosed that a local citizen, admiring its quality, had appropriated it for his nearby property. There was such a fuss made that the outhouse was reluctantly returned... only to be completely demolished in the hurricane surf of October 2, 1898, immortalizing to this day the "Privy Hurricane."

Centuries before European explorers and settlers were exposed to the hurricane's devastation, native Americans trembled helplessly before the brutal force of their seemingly infinite winds. The word hurricane itself is thought to be derived from the Carib Indians' word for evil spirit.

Hurricanes were first mentioned in the logs of Christopher Columbus, their earliest European student. After Columbus, the next major contribution to man's knowledge of the hurricane was made by Benjamin Franklin.

On November, 1743, a "noreaster," actually the outer fringes of a

hurricane raging offshore, hit Philadelphia, obscuring an expected eclipse of the Moon. Franklin, learning that the eclipse was seen at Boston (because the storm reached there later than Philadelphia) realized that the "noreaster" had moved from the southwest— despite surface winds from the opposite direction.

Six years later, Franklin verified his theory by tracking the progress of another hurricane from North Carolina through New England. This independent motion of a storm was a novel and important concept. As usual, Franklin was years ahead of his time. It wasn't until the middle of the nineteenth century that it was realized that all storms are actually circular wind systems, moving from one place to another.

In 1831, William Redfield, a Yankee student of the hurricane, showed that these giant storms were "rotary," with the winds blowing from all directions around a slowly moving center. He also traced long curved hurricane tracks from the West Indies to the east coast of the United States mainland. Later, Henry Piddington, an Englishman sent to study the devastating tropical storms of India, coined the term "cyclone" (from a Greek word meaning "the coils of a snake") to describe all rotary storms.

Benito Viñes, a Jesuit priest, contributed much to our present–day knowledge of hurricanes. He was director of the College of Belén in Havana from 1870 until his death in 1893. During those years, Father Viñes devoted all his time to the study of the hurricane, so that the Cuban people might be spared the needless tragedy a few hours' warning could prevent. His hurricane warning for Cuba on September 11,1875 was apparently the first formal hurricane warning ever issued in the Western Hemisphere.

In 1870, a U.S. national weather service was founded as a branch of the Army Signal Service. The first hurricane ever seen on a weather map appeared on the Signal Service map of September 28, 1874, located over the coastal waters between Savannah, Georgia, and Jacksonville, Florida.

The wreck of the German warship Adler at Apia, Samoa, March 16, 1889. The remaining warships of the United States and Germany, along with six merchant vessels were lost in the hurricane.

In 1891, the U.S. Weather Bureau was organized, taking over the civil duties of the Signal Corps. In 1902 Marconi invented the wireless, and at last, hurricane warnings, were no longer dependent on telegraph wires or on cables stretched across the ocean's floor. Now instantaneous reports from far–off islands, or lonely ships could give early warning... the modern age of hurricane warnings had begun.

More recently, new tools have been given the hurricane forecaster. Among these are radar and the weather satellite. Nowadays, few hurricanes roar in unheralded on helpless people. They are kept under constant surveillance from the moment of their discovery, often far out at sea.

There was even a hurricane that kept the United States out of war.

Hurricanes definitely have their place in the scheme of things. Down through the centuries they have helped shape the very environment in which we live. As we have seen, they have frequented our history, and at times have changed its course. There was even a hurricane that kept the United States out of war.

In 1888 Prince Bismarck, Chancellor of Germany, tried to establish a German protectorate in Samoa. German naval vessels destroyed some American property while shelling a native village, and German sailors ripped down and burned an American flag. U.S. warships, sped to Samoa. On March 16, 1889, as the ships of the two nations faced each other in the harbor of Apia, a savage hurricane overwhelmed them. The ships were either sunk, or wrecked and driven aground. The seamen of both nations struggled to survive... and to help one another. The island's natives came to the rescue of both. Even so, about 150 sailors drowned. It was a high price to pay, but the hurricane brought peace. In a time of mutual disaster, grievances were forgotten and differences soon resolved in the Treaty of Berlin of 1889.

The hurricane had prevented war, a worthy addition to the long line of hurricanes that have whirled through the lives of the American people from the very beginning.

Drawn by G.W. Peters, Photo by Red Cross

The Galveston Hurricane of 1900 — America's Greatest Natural Disaster

"With a raging sea rolling around them, with a wind so terrific that none could hope to escape its fury, with roofs being torn away and buildings crumbling... men , women and children ... huddled like rats in the structures. As buildings crumpled and crashed hundreds were buried under the debris, while thousands were thrown into the waters, some to meet instant death, others to struggle for a time in vain, and yet other thousands to escape death in miraculous and marvelous ways." This is an eyewitness account of the great Galveston hurricane of 1900— the 90th anniversary of the worst disaster ever to devastate an American community. The storm cut off Galveston Island from the mainland and completely submerged it under the sea. In Galveston city alone, it killed at least 6,000 men, women and children. It left 1,000 survivors naked, 5,000 more bruised and battered. In a 1,500–acre area of total destruction, 2,636 houses— nearly half the homes in the city— were swept out of existence. Elsewhere, at least 1,000 more were reduced to wreckage. Not a single building escaped damage; every survivor had faced death.

The Galveston hurricane was a far greater disaster than the Chicago fire of 1871, which killed 250 people, or the 1906 San Francisco earthquake, which killed 480, or the Johnstown Flood in 1889, which claimed 2,200 lives.

—Patrick Hughes, Editor *Weatherwise*

I Remember Camille

Dr. Patrick J. Michaels
Virginia State Climatologist

IT'S NOT EASY TO FIND SOMEONE WHO HAS SEEN A CATEGORY 5 HURRICANE MAKE LANDFALL FROM A VANTAGE POINT WITHIN 1,000 FEET OF THE BEACH, IF ONLY BECAUSE FEW PEOPLE LIVE THROUGH SUCH AN EXPERIENCE. DR. MICHAELS WAS A YOUNG TECHNICIAN AT A GULF COAST LABORATORY AND WAS ON THE BEACH WHERE BILOXI BAY MEETS THE GULF OF MEXICO THE NIGHT OF AUGUST 17, 1969.

This story was excerpted from a more detailed summary of Camille, which appeared in the Virginia Climate Advisory, Vol. 13, No. 2 Summer 1989, a publication of the Virginia State Climatology Office, Department of Environmental Sciences, University of Virginia.

"I'll never forget the day before Camille." It was a Saturday, the day when all the Gulf Coast laboratory residents (there were about 30 of us) wiled away the time fishing or playing ball. I chose the former and, as I sat on the end of the pier, I was impressed by the absolute clarity of the air and blueness of the sky. I found out later that this is typical of strong hurricanes, as the air descends and dries far away from the storm itself. A patch of thickening cirrus clouds lay on the southeastern horizon. This was the blowoff from the top of Camille.

By midday on Saturday, hurricane forecasters were already saying that conditions were so favorable for intensification that Camille, then a 115–mph storm, could eventually rival the great Labor Day Hurricane of 1935. This was of only minor concern to us, as the National Hurricane Center (NHC) was confident that upper wind profiles showing northwesterly flow along the northern Gulf would deflect the northward–moving storm to the east, with probable landfall on the relatively unpopulated coastal bend of Florida.

Just to be on the safe side, though, NHC issued a hurricane watch all the way from St. Marks, Florida to Biloxi, Mississippi. We were at the western edge of a watch area that extended hundreds of miles to our east.

Camille from afar

When the first hurricane warnings were issued, they were far to our east— from Fort Walton to St. Marks. We were even about 100 miles west of the gale warnings, which terminated in Pensacola.

My job was as a laboratory and field technician in a project studying circadian (daily) activity rhythms of the five species of Fiddler Crab that populated the beach. One of the prevailing theories was that, because they lived so close together, some would make their living by tracking the tides, while others, probably up the beach, would track the sun. My laboratory studies, conducted in an antebellum house a couple of hundred feet from shore, verified this, and I was quite a happy fellow to be experiencing scientific success at the age of 19.

Wide World

The wave setup on top of the storm surge contributed to the overall water height. The result along the coast was much the same as it was here in the debris near Bay St. Louis, MS. In some areas huge rolls of newsprint stacked on the docks acted as bowling balls, clearing everything in their path.

Another aspect of the project was to verify laboratory findings in the field, so when the moon was high, I would fire up a Coleman lantern, find a place to sit, and count crabs. During my expedition on Saturday night (August 16) I convinced myself something was wrong with the forecast of landfall 200 miles to the east.

A queasy feeling

A small thunderstorm had formed some 20 miles north of the laboratory, and it's outline was easy to see in the bright moonlight. If Camille were indeed going to turn to the northeast, the same winds steering that thunderstorm should have blown it somewhere to the right of due north. My pulse quickened as the thunderhead drifted slowly to the west.

Camille was beginning to modify her own environment in a way that allowed her to continue in the same direction, rather than deflecting to the northeast. It turns out, I found out later, that this is a characteristic of the strongest of hurricanes.

My immediate reaction was to abandon the crabs, and run back to the Laboratory to inform all who would listen that Camille was headed our way. I experienced considerable skepticism.

Within a half hour, the Administrative Director for the laboratory was pounding on my door and everyone else's. "NHC's changed their forecast", he said, "and they say she's headed here."

ADVISORY NO. 13 5 AM SUNDAY AUGUST 17,1969

CAMILLE...EXTREMELY DANGEROUS...SHIFTS A LITTLE WESTWARD...THREATENS MISSISSIPPI...ALABAMA...AND NORTHWEST FLORIDA COASTS...

HURRICANE WARNINGS HAVE BEEN EXTENDED WESTWARD TO BILOXI INCLUDING THE ALABAMA COAST AND THE PENSACOLA AREA. HURRICANE WARNINGS ARE NOW IN EFFECT FROM BILOXI MISSISSIPPI TO ST. MARKS FLORIDA...

AT 5AM CDT...HURRICANE CAMILLE WAS LOCATED NEAR LATITUDE 26.9 NORTH...LONGITUDE 87.9 WEST...OR ABOUT 250 MILES SOUTH OF MOBILE ALABAMA...

HIGHEST WINDS ARE ESTIMATED 160 MPH NEAR THE CENTER...

CONNER/NEW ORLEANS

What a difference a day made. By sunrise, the sky was completely overcast, and to the south, towards the heart of Camille, it was very, very dark. By 8:00 a.m. traffic was streaming northward and local stores were jammed. About 20 of us decided to stay in the laboratory's new dormitory—a building specifically designed to withstand all but the hurricane storm surge—as evidenced by the cable–tied girders that anchored the roof. We took up a collection, went to town, and bought batteries, canned food and every bottle of Jax beer we could find.

NHC's 2–hourly bulletins continued to escalate the threat. Each new one seemed to lower the central pressure and jack up the maximum winds and storm surge. In 48 hours, Camille had grown from a tropical storm with maximum sustained winds of 65 mph, in the words of NHC, "Plodding towards the Isle of Pines," to "extremely dangerous."

I went to the antebellum house to remove my equipment. I left the sea level recorder out on the pier, knowing full well that it was one of very few that could document Camille's landfall. Soon, Keesler Air Force Base in Biloxi called, and asked if we could provide them with half–hour readings as long as possible. A motorist came by towing a boat, which he lashed to a telephone pole some 200 feet from the shore. I asked if I could be of assistance. No, he said, just come back tomorrow and help us pick up the pieces.

I still didn't comprehend what was about to happen. That recon flight actually estimated highest surface winds at 180 knots, or 200 mph. In doing so, it lost an engine, ending aerial observation of Camille. I checked my map: by air, it was 18 miles from where I was to the center of Gulfport. Allowing for a 5 mile radius in the eye, that put me 13 miles from the northeast eyewall. I looked at the steel girders and their cable anchors.

Nothing much happened that afternoon except gusty winds and rain. The signal characteristic of the day was cold. After enduring one of the area's hottest summers of record (indeed, the very warm Gulf waters was one of the reasons for Camille's ferocity), a 20–mph northeast wind and intermittent showers raised goosebumps.

By 6:00 p.m. the water began to rise and was just to the top of the pier. Telephones still worked, and I called Keesler with the tide reading. As darkness fell, Camille started in earnest. While our winds began to gust through tropical storm strength, a recording anemometer on an evacuated oil rig some 75 miles to the south hit 173 mph and promptly jammed over an hour before the center passed by. Camille was moving north at about 15 mph. That meant winds at least 20 miles from the storm center were equivalent to a severe tornado. I read later, according to a tornado scientist, that this would cause: "roofs and some walls torn off well–constructed frame houses; most trees in a forest uprooted, snapped, or leveled. Block structures often leveled."

Up close and personal

I went out to check the tide gauge at 7:30, and found water about a foot over the pier. That was the last I saw of either. I called Keesler, and the radar operator informed me that a very bright band would be heading onshore in the next hour. He asked if we were secure. The bright band was the real Camille, which began to make landfall around dusk. The observers at Keesler had retreated to their mess hall, and soon were forced to climb on the tables to stay above the water. It wasn't until dawn that they realized that hundreds of snakes had taken refuge with them. The U.S. Weather Bureau radar at New Orleans showed Camille's eye on the Mississippi coast.

The next 4 hours were chaotic. The closest I can come to describing the sound is that it's like being on the

SPECIAL ADVISORY NO. 16 3 PM CDT SUNDAY AUGUST 17,1969

CAMILLE...EXTREMELY DANGEROUS...CENTER NEAR THE MOUTH OF THE MISSISSIPPI RIVER...BEARING DOWN ON MISSISSIPPI ALABAMA COAST...

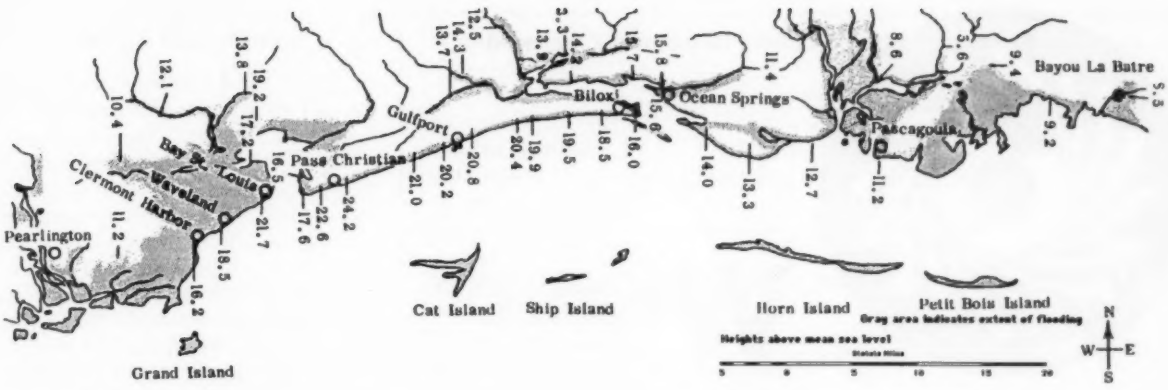
HURRICANE WARNINGS ARE IN EFFECT FROM NEW ORLEANS AND GRAND ISLE LOUISIANA EASTWARD ACROSS THE MISSISSIPPI...ALABAMA...AND NORTHWEST FLORIDA COAST TO APALACHICOLA...PREPARATIONS AGAINST THIS EXTREMELY DANGEROUS HURRICANE SHOULD BE COMPLETED BEFORE DARK...

WINDS ARE INCREASING AND TIDES ARE RISING ALONG THE NORTHERN GULF COAST FROM GRAND ISLE EASTWARD. WINDS AT THE MOUTH OF THE MISSISSIPPI RIVER ARE NOW NEAR HURRICANE FORCE. THE FOLLOWING TIDES ARE EXPECTED TONIGHT AS CAMILLE MOVES INLAND: MISSISSIPPI COAST GULFPORT TO PASCAGOULA 15 TO 20 FEET...PASCAGOULA TO MOBILE 10 TO 15 FEET...IMMEDIATE EVACUATION OF AREAS THAT WILL BE AFFECTED BY THESE TIDES IS ADVISED.

...AT 3PM...HURRICANE CAMILLE WAS LOCATED NEAR LATITUDE 28.6 NORTH...LONGITUDE 88.8 WEST...OR ABOUT 120 MILES SOUTHEAST OF NEW ORLEANS. CAMILLE WAS MOVING NORTH NORTHWEST 15 TO 18 MPH.

AN AIR FORCE RECON FLIGHT INTO CAMILLE THIS AFTERNOON ESTIMATED THE WINDS 190 MPH NEAR THE CENTER. THE CENTRAL PRESSURE WAS 26.61 INCHES...

CONNER/NEW ORLEANS



observation deck at a major airport. My first surprise was how discontinuous the wind was at the beginning of the storm. It would drop down to, say 30 mph or so for what seemed like a minute. Then there would be a rumble—exactly like a jet on takeoff—that you could hear in the distance, and finally the trees would begin to bend. With each succeeding wave more trees were snapped at ground level. Sixty-year old pine trees produce a considerable report when they break.

Around 9:30 two of the more intrepid members of our group put on motorcycle helmets and ran down to see where the water was during one of the lulls. We could see their flashlights bobbing as they ran back up the road. The jet roar started and the flashlights disappeared as they dove for cover in the pilings that supported our dining hall.

As soon as they ducked, two large pine trees fell right where they would have been had they continued running. When they made it back to the dormitory, they said that the Gulf was up to the back side of the old house.

I was standing in a protective alcove during one of the jet blasts when a pine needle lodged in my leg. Curious, I thought. Now I believe those stories about straws, telephone poles, and tornados.

At 10:55 p.m. Keesler, some 7 miles to our west, reported, via ham radio, winds of 150 mph. By 11:30 it roared constantly. To the southwest—in the direction of the eyewall— lightning flashed continuously. The northeast corner of the eye was now brushing the mainland at the western edge of Bay St. Louis, 26 miles away. Camille, which had tracked slightly to the west of the NHC forecast for 36 hours, finally hit land 10 miles west of Gulfport. That 10 mile error saved my life.

Nightmare on Rt 90

At 11:30 the 24.2-foot storm surge hit Pass Christian, 19 miles to the west. Twenty-five people my age also decided to ride it out in the Richelieu Apartments. Two escaped with serious injuries and the rest were swept into the ocean. Our dormitory was 20 feet above sea level.

At 11:38 p.m., just ahead of the eye, Bay St. Louis reported a wind of 190 mph. According to Dr. Simpson (Chief, NHC), "....from an appraisal of the character of splintering of structures within a few hundred yards of the coast, velocities probably approached 175 knots" (193 mph).

At that time we decided to move to the upper floor. On the way up I noticed that the rain tasted like salt water. In fact, it was salt spray from the wind-whipped waves.

What I didn't know, and couldn't see through all the chaos, was that the Gulf of Mexico was in our parking lot. Riding ahead of the storm surge were remnants of 15 or so buildings that comprised most of the Laboratory. These had formed a battering ram and were taking everything seaward with them. With any small amount of undermining, the hurricane proof roof—designed to withstand excessive winds by being anchored to the ground— would come crashing down on us. To this day, I am convinced that the other fluke that saved us was darkness. I am sure that if we had seen the surge that we would have broken and run amidst the crashing trees.

By 2 a.m. the roar finally began to subside. Then, far off in the distance I could hear the sound of more trees breaking than I had heard in any short time all evening. I lay in bed waiting for one to come through the roof as the tornado went overhead. When we finally were able to get about, we found several swaths, within a few miles, where tornados had mowed the forest.

The next thing I knew it was daylight, with the sun shining as brilliantly as it did on Saturday. One of my friends was banging on my door, and he kept repeating, "You 'are not going to believe it, You 'are not going to believe it."

The administration building and the dormitories were the only buildings intact. The dining hall was partially washed away. Every other structure was swept away. The old house had seen over 100 years of hurricanes, but Camille was its last. I found my fishing pole that I stored there, broken in two beneath a pile of bricks that was the chimney.

I found the rope that tied the boat to the telephone pole, wrapped at the top of the pole. One board of the boat remained attached, flapping 15 feet above the ground. We spent the next two weeks sifting through debris.

North Atlantic Tropical Cyclones, 1989

Max Mayfield and Bob Case
National Hurricane Center

Out of Africa— This season the recent trend for large, Cape Verde type hurricanes continued. One of these, Hurricane Hugo, became the most costly hurricane in history.

While tropical cyclone activity for the Atlantic, Caribbean and Gulf of Mexico was just slightly above normal, the trend for large, strong Cape Verde hurricanes continued. Hurricane Hugo reached category five on the Saffir/Simpson Scale and caused an estimated $7 billion damage in the U.S. and $3 billion elsewhere. Gabrielle was another large Cape Verde type that reached category four, but remained at sea.

It appears from the relatively small number of ships reporting 50 knots or greater that shipping was able to avoid this season's intense tropical cyclones. Although routinely available satellite imagery is one of the primary observational tools, ship reports retain their significance to tropical weather forecasters, particularly during the initial development phase of cyclones where surface truth is important in documenting the correct intensity.

Elaine Barto (right) and her daughter Mellisa show a moment of shock as they look at the remains of their home in Folly Beach, SC. The beach front home was destroyed by Hurricane Hugo on the 21st of September when Hugo hit the South Carolina coast. Boston Globe photo by Barry Chin.

Max Mayfield and Bob Case are forecasters at the National Hurricane Center, Miami, Florida.

Tropical Storm Allison

Tropical Storm Allison developed from the remnants of eastern Pacific Hurricane Cosme and a tropical wave. Based upon observations from offshore oil rigs and coastal surface data, a tropical depression formed on the 24th. It was upgraded to tropical storm status on the 26th based on a wind report of 35 knots with gusts to 45 knots from the ***M/T Jacinth***, some 100 nautical miles northeast of the center. Allison moved inland over the mid Texas coast, near the northeast end of Matagorda Bay, with a central pressure of 1002 millibars but continued to strengthen slightly over the next 12 hours as the central pressure dropped to 999 millibars on the 27th.

Torrential rains accompanying Allison fell along the upper Texas coast and over the western two–thirds of Louisiana. Nearly 30 inches of rain fell in a 6–day period at a few locations in north–central Louisiana. The death toll in Allison was 11, all attributed to drowning. Estimated damage is near one half billion dollars, due mainly to flooding.

Monthly Summary of 1989 Atlantic Tropical Cyclones

	Jun	Jul	Aug	Sep	Oct	Nov	Total
Tropical Depressions	1	0	2	0	1	0	4
Tropical Storms	1	1	0	1	0	1	4
Hurricanes	0	2	3	1	1	0	7
Total	2	3	5	2	2	1	15

(Tropical cyclones are assigned to the month in which they first became a tropical depression)

Wide World

Tropical Storm Barry

A tropical depression developed on the 9th of July, while located midway between Africa and the Lesser Antilles. The depression tracked northwestward and was upgraded to tropical storm strength on the 11th based on satellite intensity estimates. A 35–knot wind reported later by the ***Sirius***, located 15 nautical miles north northeast of the center, confirmed the tropical storm status. Barry weakened to a depression on the 13th.

Hurricane Chantal

Chantal, the first hurricane of the season, was detected on the 24th of July as a disturbance near Trinidad. Ships and satellites indicated that a tropical depression formed on the 30th. The depression became a tropical storm on the 31st, when an Air Force reconnaissance plane estimated maximum surface winds of 45 knots, while the ***Saudi Diriyah*** reported a 50–knot wind on the east side of the storm center. Chantal continued strengthening while moving northwest toward the upper Texas coast and was upgraded to a hurricane by the 1st of August. Chantal reached its peak, just prior to the center making landfall at High Island, Texas with top winds of 70 knots.

Thirteen deaths were attributed to Chantal and, just as in Allison, all were the result of drowning. The main effects were flooding, by torrential rains, and beach erosion. Total damage is estimated to be near $100 million.

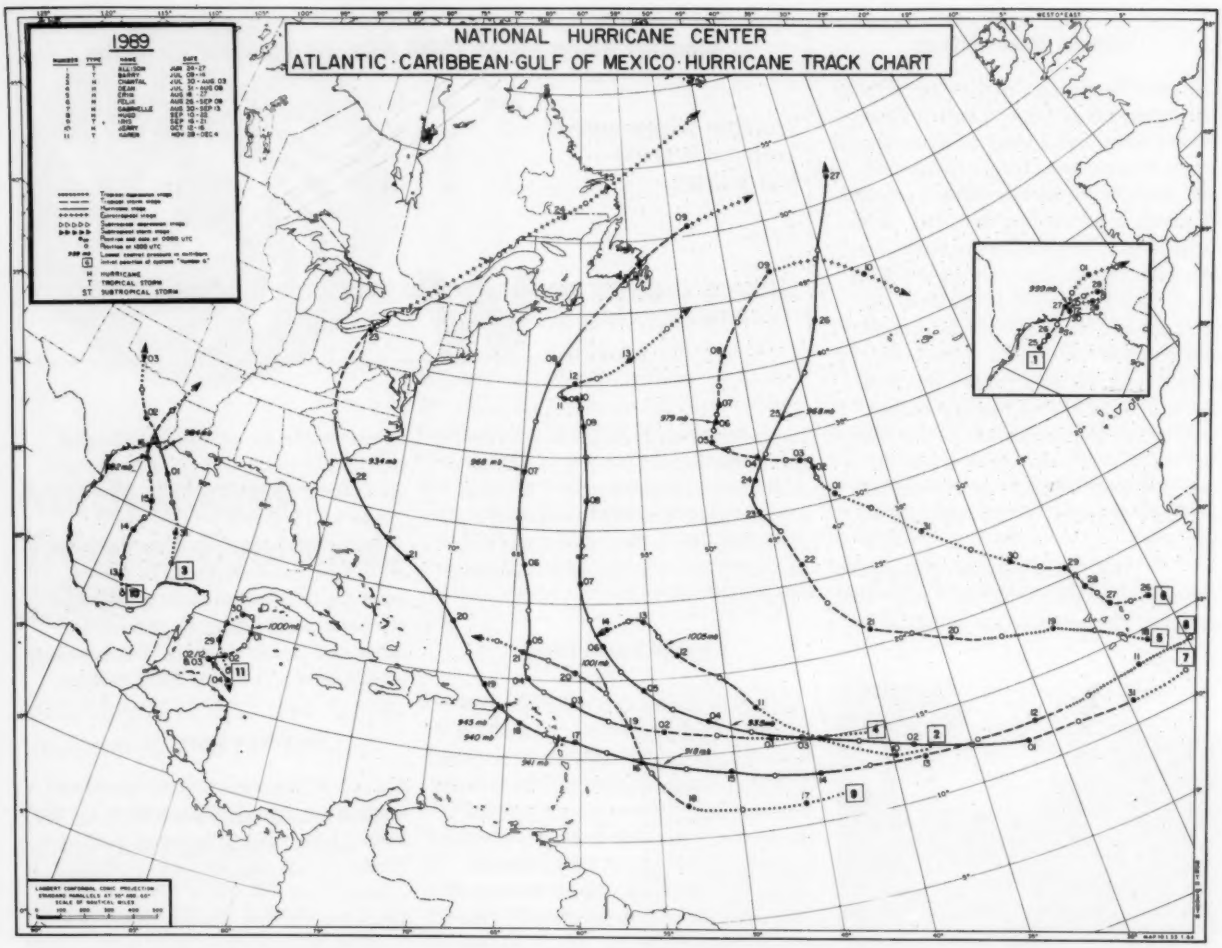
Hurricane Dean

A tropical depression developed from a westward–moving tropical wave, on the 31st of July, midway between the Cape Verde Islands and the Lesser Antilles. It attained tropical storm strength by the 1st of August and was upgraded to a hurricane on the 2d.

By the 3d, the hurricane slowed and began to turn toward the north. This brought the eastern eyewall over Bermuda on the 6th. The highest sustained wind was 70 knots with gusts to 98 knots at the U.S. Naval Annex on the western end of Bermuda.

After Bermuda, Dean accelerated toward the northeast. It passed over Sable Island, Nova Scotia, generating winds of 66 knots with gusts to 77 knots. Dean began to lose tropical characteristics as it moved over southeastern Newfoundland, and became extratropical over the North Atlantic.

There were no reported deaths due to Hurricane Dean. However, 16 people were injured on Bermuda, and damage estimated there was nearly $9 million.



Hurricane Erin

This system became a tropical depression near the Cape Verde Islands on August 18th. Steering currents guided it toward the northwest, and it was upgraded to Tropical Storm Erin on the 19th based on satellite imagery. A 65–knot wind reported by the Portuguese ship ***Montemuro*** resulted in Erin being upgraded to a hurricane on the 22d. Satellite intensity estimates indicated Erin strengthened to a 968–millibar hurricane with peak winds of 90 knots on the 25th. Thereafter Erin accelerated toward the northeast, weakened to a tropical storm on the 27th, and soon became extratropical.

Hurricane Felix

Felix persevered mostly in the shadow of the much larger and more intense Hurricane Gabrielle to become the longest lasting tropical cyclone of the season.

After emerging from the African coast, on the 25th of August, Felix turned northwestward. From the 26th of August to the 5th of September, Felix strengthened to a storm, weakened to a tropical depression, regained storm status, and finally attained hurricane strength.

Based on satellite imagery, the hurricane's minimum central pressure of 979 millibars with maximum sustained winds of 75 knots occurred from late on the 5th to early on the 6th. Ship reports were rather sparse around Felix with the only significant weather observation from the ***OOCL Atlantic***, which observed 40–knot winds with heavy rain just north of the center on the 8th. As Felix came under the influence of the westerlies and moved over the cooler waters, it became extratropical on the 9th. This system became a large non–tropical storm during the next few days and eventually dissipated southeast of the Azores by the 15th. Several ships observed winds near 50 knots around the circulation during the extratropical stage.

Hurricane Gabrielle

A tropical wave moved off the African coast on the 28th of August. It reached tropical depression strength on the 30th and was upgraded to Tropical Storm Gabrielle on the 31st.

The first reconnaissance aircraft into Gabrielle found a central pressure of 935 millibars on the 3d of September. The hurricane's central pressure remained in the low 940–millibar range for the next 3 days, with the strongest surface winds estimated to be near 125 knots.

After the 4th of September, Gabrielle turned toward the north, passing about 300 nautical miles northeast of the northeastern Caribbean islands. On the 10th Gabrielle became nearly stationary about 475 nautical miles east southeast of Cape Cod, Massachusetts. It drifted slowly westward and dropped to tropical storm strength on the 10th and to a depression by the 12th. The following day it lost most of its tropical characteristics and merged with a developing North Atlantic storm off Newfoundland.

Gabrielle was a very large hurricane. The eye diameter was never less than 20 nautical miles, and, while the hurricane was most intense, this diameter ranged from 40 to 50 nautical miles. Hurricane–force winds frequently extended in excess of 100 nautical miles from the center. Reports of 50– to 60–knot winds were received from the EOC3 and ***Mikhail Stelmakh***, on the 7th and 8th, some 125 to 160 nautical miles from the center. Gabrielle's powerful winds covered a large area of the Atlantic and generated large ocean swells, which pounded the shores of the northeastern Caribbean islands, Bermuda and the North American mainland from central Florida to the Canadian Maritimes. Swells ranged from 10 to 15 feet along portions of the U.S. East Coast and were as high as 20 to 30 feet along the south coast of Nova Scotia. These swells were responsible for eight deaths along the mid–Atlantic and New England coasts. Accidents ranged from people being swept from jetties while watching the large swells to boats capsizing while trying to enter or leave inlets.

Hurricane Hugo

Hugo, the strongest hurricane of 1989, left a path of death and destruction across the Leeward Islands, the Virgin Islands, Puerto Rico, and South and North Carolina.

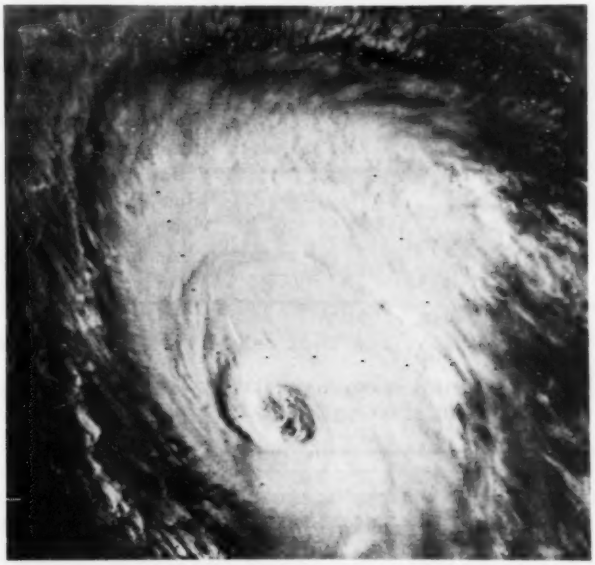
Hugo was first detected by satellite, on the 9th of September, as a cluster of thunderstorms off the coast of Africa. A tropical depression formed southeast of the Cape Verde Islands and moved westward across the tropical Atlantic Ocean at 18 knots. It became a tropical storm on the 13th about 1100 nautical miles east of the Leeward Islands.

Hugo gradually turned toward the west northwest and slowed. On the 15th, Air Force and NOAA reconnaissance aircraft reached the hurricane several hundred miles east of the Leeward Islands and reported a central pressure of 918 millibars, a wind speed of 165 knots at an altitude of 1500 feet, and an estimated surface wind speed of 140 knots. This was Hugo's maximum intensity and earned the hurricane a category five rating.

Hugo crossed Guadeloupe on the 17th with a central pressure of 941 millibars and 120–knot winds. The hurricane turned northwestward and hit St. Croix the next day, with maximum surface winds remaining near 120 knots.

Accelerating, the eye moved over the island of Vieques, Puerto Rico, and then over the extreme eastern tip of mainland Puerto Rico on the 18th. Maximum winds were estimated at 110 knots. The lowest recorded surface pressure on the island was 946.1 millibars at Roosevelt Roads.

Hugo then took aim on the South Carolina coast. It made its final landfall on the 22d at Sullivan's Island, near Charleston. Based on a reconnaissance aircraft measurement of 934 millibars and 140–knot winds at an altitude of 12,000 feet just before landfall, the surface wind at landfall was estimated to be 120 knots. A report of 76 knots with a gust to 94 knots was received from downtown Charleston. However, the strongest winds probably occurred 20 nautical miles or so to the northeast of Charleston, near Bulls Bay. The strongest sustained surface wind measured was 104 knots from the ship ***Snow Goose***, anchored in the Sampit River, a few nautical miles west of Georgetown, South Carolina. This



To the right is a GOES Visible image of Hurricane Gabrielle at 1231 UTC on the 6th of September 1989, over the open Atlantic.

A large passenger craft is beached at Pointe–a–Pitre, Guadeloupe (left) on the 18th during Hugo. At far right, Hugo leaves little untouched on the barrier island of Isle of Palms, South Carolina after it passed on the 22d.

Wide World

measurement was taken from a three–cup Tradewind anemometer located on the ship's mast at an elevation of 61 feet.

Moving inland and weakening, the center passed between Columbia and Shaw Air Force Base prior to sunrise on the 22d. The air base reported a sustained wind of 58 knots with a gust to 95 knots. By sunrise Hugo was a tropical storm and had passed just west of Charlotte, North Carolina, with winds of 60 knots and gusts to 86 knots. Moving northward across extreme western Virginia, West Virginia, and eastern Ohio, Hugo became extratropical near Erie, Pennsylvania, on the 23d. During the next 2 days it moved across eastern Canada and into the far northern Atlantic Ocean.

Storm tides along the South Carolina coast ranged from 8 to 10 feet in the Charleston–Folly Beach area to near 20 feet in the south end of Bulls Bay and down to 7 feet at Winyah Bay. The storm surge was reported at 4 feet above the predicted tide as far north as Hatteras, North Carolina.

Rainfall totals ranged from a trace at Jacksonville, Florida, to 6.10 inches at Savannah, Georgia, to a maximum of 8.10 inches at Mt. Pleasant, South Carolina (near Charleston), to 2.30 inches at Myrtle Beach, South Carolina, and 0.58 inches at Hatteras, North Carolina. A 150–nautical–mile–wide swath of 3 to 8 inches of rain spread inland across South Carolina and continued over western North Carolina, with a maximum of 6.91 inches reported at Boone. Rainfall totals were in the 2– to 4–inch range across western Virginia, West Virginia, western Pennsylvania, eastern Ohio, and western New York.

The total number of deaths associated with Hugo is estimated at 49, 21 on the U.S. mainland. The $10–billion damage estimate makes Hugo the most costly hurricane in history.

1989 Atlantic Hurricane Season Statistics

no.	name	class[1]	dates[2]	maximum sustained wind (knots)	lowest press. (mb)	U.S. damage ($millions)	deaths
1	Allison	T	24-27 Jun	45	999	500	11
2	Barry	T	9-14 Jul	45	1005		
3	Chantal	H	30 Jul-3 Aug	70	984	100	13
4	Dean	H	31 Jul-8 Aug	90	968		
5	Erin	H	18-27 Aug	90	968		
6	Felix	H	26 Aug-9 Sep	75	979		
7	Gabrielle	H	30 Aug-13 Sep	125	935		8
8	Hugo	H	10-22 Sep	140	918	7000	49
9	Iris	T	16-21 Sep	60	1001		
10	Jerry	H	12-16 Oct	75	982	70	3
11	Karen	T	28 Nov-4 Dec	50	1000		

1 T: tropical storm, wind speed 34-63 kt.
H: hurricane, wind speed 64 kt or higher.

2 Dates begin at 0000 UTC and include tropical depression stage.

Tropical Storm Iris

The tropical wave that spawned Iris was immediately behind the wave that spawned Hugo. Although the system remained in the unfavorable environment of Hugo's wake, a tropical depression formed on the 16th of September and reached tropical storm strength, 390 miles east of Barbados on the 18th. Iris turned northwestward and reached its maximum strength of 1001 millibars, with estimated 60–knot surface winds, on the 19th. Thereafter, increased outflow from the powerful and strengthening Hugo resulted in Iris' weakening, with satellite images eventually showing the low–level center exposed from the deep convection.

Hurricane Jerry

Jerry originated from a tropical wave that moved across the tropical Atlantic and Caribbean Sea. There were no additional signs of organization before it developed into a tropical depression on the 12th of October as it moved into the Bay of Campeche.

Wide World

The depression attained tropical storm strength on the 13th. After some hesitation, shearing and a temporary turn to the northeast, Jerry turned toward the north northwest on the 15th and strengthened to a hurricane.

Jerry made landfall on Galveston Island, near Jamaica Beach, on the 16th. No hurricane had ever made landfall on the upper Texas coast so late in the season. Once inland, Jerry moved over eastern Texas, weakened rapidly, and was absorbed by a frontal trough late on the 16th.

Maximum sustained surface winds of 65 knots with gusts to 87 knots were measured at Scholes Field on Galveston Island as the eyewall passed over the airport. The observation site lost power near this time, and the observer–estimated maximum sustained winds reached 70 knots with gusts of 90 to 100 knots. An extrapolated minimum pressure of 982 millibars was reported by a NOAA aircraft and by an Air Force plane just prior to landfall.

Three people were reported killed, all by drowning. Damage estimates for the hurricane are near 70 million dollars.

Tropical Cyclone Winds
(ship encounters of 50 knots or more)

Tropical Cyclone	Vessel Name	Date Mo/Da	Time UTC	Ship Position Lat N, Lon W		Wind Dir/Speed (kn)	Pressure (mb)
Chantal	***Saudi Diriyah***	7/31	1200	26.1	89.2	130/50	1009.3
Erin	***Montemuro***	8/22	1200	28.5	45.0	270/65	1000.3
	Merida	8/24	1200	32.1	43.5	200/55	1011.5
	Maris Gorthon	8/26	1800	49.0	32.0	160/50	1003.5
Gabrielle	**EOC3**	9/07	1200	29.9	57.4	150/57	997.0
	Mikhail Stelmakh	9/08	0600	34.6	56.8	160/50	993.0
	Yan Kalnberzine	9/12	1200	36.7	58.3	210/50	1018.0
	Trudy	9/13	1200	44.5	56.3	330/52	1014.6

Tropical Storm Karen

Satellite imagery indicated, and aircraft reconnaissance confirmed, a tropical depression formed in the northwest Caribbean on the 28th of November. It was upgraded to Tropical Storm Karen near the Isle of Youth, Cuba, early on the 30th. Karen became the eighth named tropical cyclone to form in November during the past 10 years. This is double the long–term average.

A minimum central pressure of 1000 millibars, with strongest winds of 50 knots, was reached later on the 30th. Karen was a wet storm that dropped 10 to 15 inches of rain over portions of western Cuba.

A strong high pressure system over the Gulf of Mexico forced Karen to move to the south and southwest from late on the 30th to the 3d of December. The last advisory of the 1989 Atlantic hurricane season was issued on the 4th of December after an Air Force plane was unable to locate a circulation center.

Eastern North Pacific Tropical Cyclones, 1989

Miles Lawrence
National Hurricane Center

This year Hurricanes Cosme and Kiko made landfall in Mexico as did Tropical Storm Raymond. Octave's remnants were tracked across southern California.

The origins of all but one of this year's storms and hurricanes were associated with westward–moving tropical waves which came from the Atlantic basin. Kiko, which developed within a cloud system that originated over mainland Mexico, was the only exception.

This season's eight tropical storms and nine hurricanes were near the long–term average of 7.4 storms and 8.2 hurricanes.

Eastern Pacific tropical cyclones ordinarily move on a west through northwestward heading and dissipate over cold water without affecting land. This year, Hurricanes Cosme and Kiko and Tropical Storm Raymond made landfall in Mexico, while the remnants of Octave were tracked over southern California.

There are no damage estimates available from Mexico. However, it is estimated that Cosme caused 10 deaths in Mexico from heavy rain which produced inland flash flooding. Ismael, in addition, was responsible for 3 deaths.

Hurricane Barbara

Barbara developed from a slow–moving tropical wave which crossed Central America on June 8th. Eventually, on the 15th, the wave was upgraded to a tropical depression several hundred miles south of Puerto Vallarta, Mexico and was then named Tropical Storm Barbara on the 16th.

The storm strengthened as it moved northwestward and was upgraded to a hurricane on the 18th. Barbara remained a minimal hurricane for 24 hours and then weakened as air moving over cooler water was entrained into the system from the northwest. By the 20th, all that remained of Barbara was a westward–moving swirl in the low–level stratocumulus clouds.

Hurricane Cosme

While Barbara was weakening, a tropical depression formed to the south of Acapulco, Mexico, on June 18. It was associated with a 2–week old African tropical wave. During June 17–18, several different centers were observed before a single center became well organized. The depression was designated Tropical Storm Cosme on June

Monthly Summary of 1989 Tropical Cyclones

	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Tropical Depressions	0	0	3	0	1	3	0	7
Tropical Storms	1	0	2	3	2	0	0	8
Hurricanes	0	2	2	3	2	0	0	9
Total	1	2	7	6	5	3	0	24

(Tropical cyclones are assigned to the month in which they first became a tropical depression)

Miles Lawrence is a forecaster at the National Hurricane Center, Miami, Florida.

20 and Cosme attained hurricane strength the following day.

During the 19th and 20th, the hurricane remained nearly stationary as the circulation gradually organized. After attaining hurricane status, it accelerated northward and moved onshore just east of Acapulco on the night of the 21st. The weakening remnants of Cosme accelerated northward through eastern Mexico. The circulation was last identified as a cloud swirl south of Brownsville, Texas, on the 23d and assisted in the development of Tropical Storm Allison.

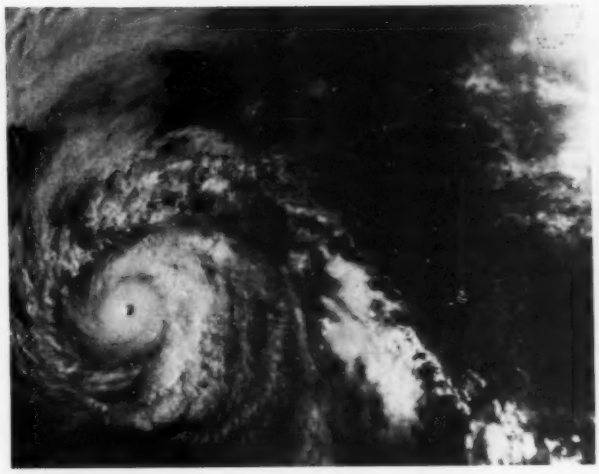
Maximum sustained winds of 75 knots and a lowest sea–level pressure of 979 millibars were estimated just prior to landfall, based on satellite data. The highest recorded winds in Acapulco were 30 knots with gusts to 40 knots. Winds gusted to 50 knots at Puerto Escondido, Mexico, some 150 nautical miles east of where Cosme made landfall. The maximum wind observed by a ship was 55 knots, reported from the ***Keystoner***, just east of the center, at 0000 UTC on the 22d. Two other ships, ***Sammi Super Stars*** and ***Toyofuji No. 10***, reported gale–force winds.

Heavy rains accompanied the hurricane over southern Mexico with reports of flash floods and mudslides over the coastal mountains. Rainfall amounts in excess of 5 inches during a 12–hour period were recorded along the coast of Acapulco during the night of the 21st.

The Mexican government reported 10 deaths due to drowning. Many adobe houses were destroyed by floods.

Hurricane Dalilia

Dalilia began when an area of thunderstorms in the Intertropical Convergence Zone became separated from its surrounding cloudiness on July 9th. Moving westward, this low–latitude system became a tropical depression on the 11th about 750 nautical miles south of the southern tip of Baja California.



Hurricane Ismael is southwest of the Baja Peninsula on the 19th of August, at about 1630 UTC. At this time the well–developed storm was generating 105–knot winds near its center.

It strengthened to a storm on the 12th and to a hurricane on the 13th.

Dalilia reached peak strength on the 16th when its maximum one-minute wind speed was estimated at 80 knots, based on satellite observations. Reconnaissance aircraft flew into Dalilia on the 18–20th, when Hawaii was being threatened, but by this time Dalilia had weakened to a tropical storm.

Hurricane Gil

Gil originated from an area of disturbed weather, on July 27th, south of Mexico and Guatemala. At first, a weak circulation formed on the 28th and was tracked to the Gulf of Tehuantepec where it dissipated. Then a new circulation formed about 200 nautical miles south of Acapulco on the 30th and Gil's track began.

The circulation paralleled the coast of Mexico, from the 30th through August 5th, when it dissipated about 250 nautical miles west of Baja California. Based on satellite estimates, it became a hurricane late on the 31st and remained so for 30 hours, with highest winds of 75 knots. The center of Gil passed 75 nautical miles northeast of Socorro Island on the 1st. Even though Gil was estimated to be a hurricane at the time, the few surface wind reports from the island indicated that the winds there remained under 10 knots. However, rainfall on the island totalled 4.8 inches for a 12–hour period on the 1st. Also, the ***Continental Wing*** reported 33 knots at 1800 UTC on the 2d, 90 nautical miles northeast of Gil's center.

Hurricane Ismael

Ismael came to life on August 14th about 250 nautical miles south southeast of Acapulco. Initially moving northwestward, it strengthened to a tropical storm on the 15th while producing heavy rainfall and flash flooding along the southwestern coastal sections of Mexico. On the 16th, Ismael turned toward the west and further strengthened to a hurricane.

During the 7 days that Ismael was a hurricane, it went through several fluctuations in strength. Colder sea surface temperatures and upper level shearing took their toll and Ismael weakened to a tropical storm on the 23d and to a depression on the 25th.

Ismael reached maximum intensity on the 19th with 105–knot sustained winds based on satellite estimates. The highest observed wind speed was 33 knots from the ***Izola***, about 75 nautical miles northeast of the center on the 16th when Ismael was still a tropical storm. Three deaths were attributed to Ismael.

Hurricane Kiko

On August 23d satellite imagery revealed a large mesoscale convective system developing over northwest Mexico. It moved southward and a tropical depression formed on the 25th just west of the Islas Marias.

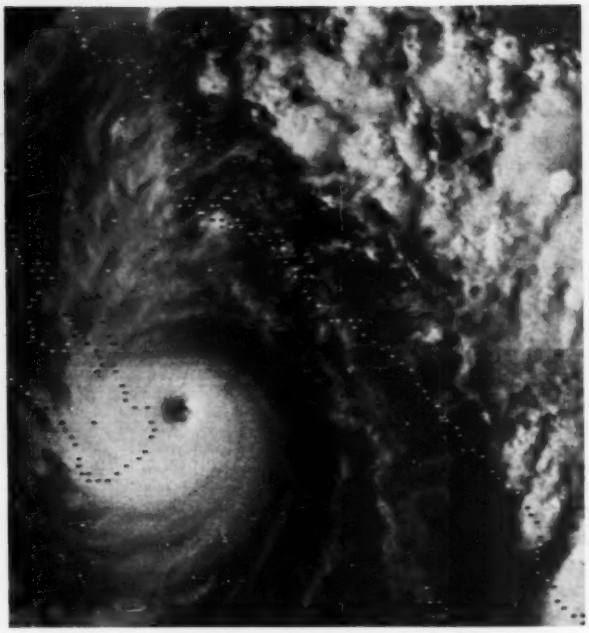
Kiko reached hurricane status on the 26th when an eye embedded within a small central dense overcast was spotted by satellite. Rapid development continued and a maximum wind of 105 knots was estimated at 0000 UTC on the 27th, while Kiko was centered just east of the southern tip of Baja California. It made landfall near Punta Arena, about 6 hours later.

Because the hurricane was small and slow, it weakened rapidly over the mountainous terrain of the Baja. Kiko was downgraded to a tropical storm on the 27th and to a tropical depression on the next day as the center emerged off the west coast of Baja. Turning southwestward, it began to interact with Tropical Storm Lorena to the southeast. The depression diminished and was eventually absorbed within the circulation of Tropical Storm Lorena.

A hotel owner on Cabo San Lucas relayed ship reports from outside the Cabo San Lucas harbor of northwest winds of 25 to 30 knots at 1900 UTC on the 26th. A ham radio report from near Punta Arena at 0130 UTC on the 27th listed northerly winds of 35 to 40 knots with gusts to 55 knots while Kiko was just offshore. The hurricane made landfall during the night in an area with limited observations, although torrential rains were reported from Cabo San Lucas and Todos Santos during the 27th.

Hurricane Lorena

Lorena developed about 300 nautical miles south southwest of Manzanillo, Mexico on August 27th. A depression strengthened to Tropical Storm Lorena about 24 hours later. Lorena moved west northwestward for several days and



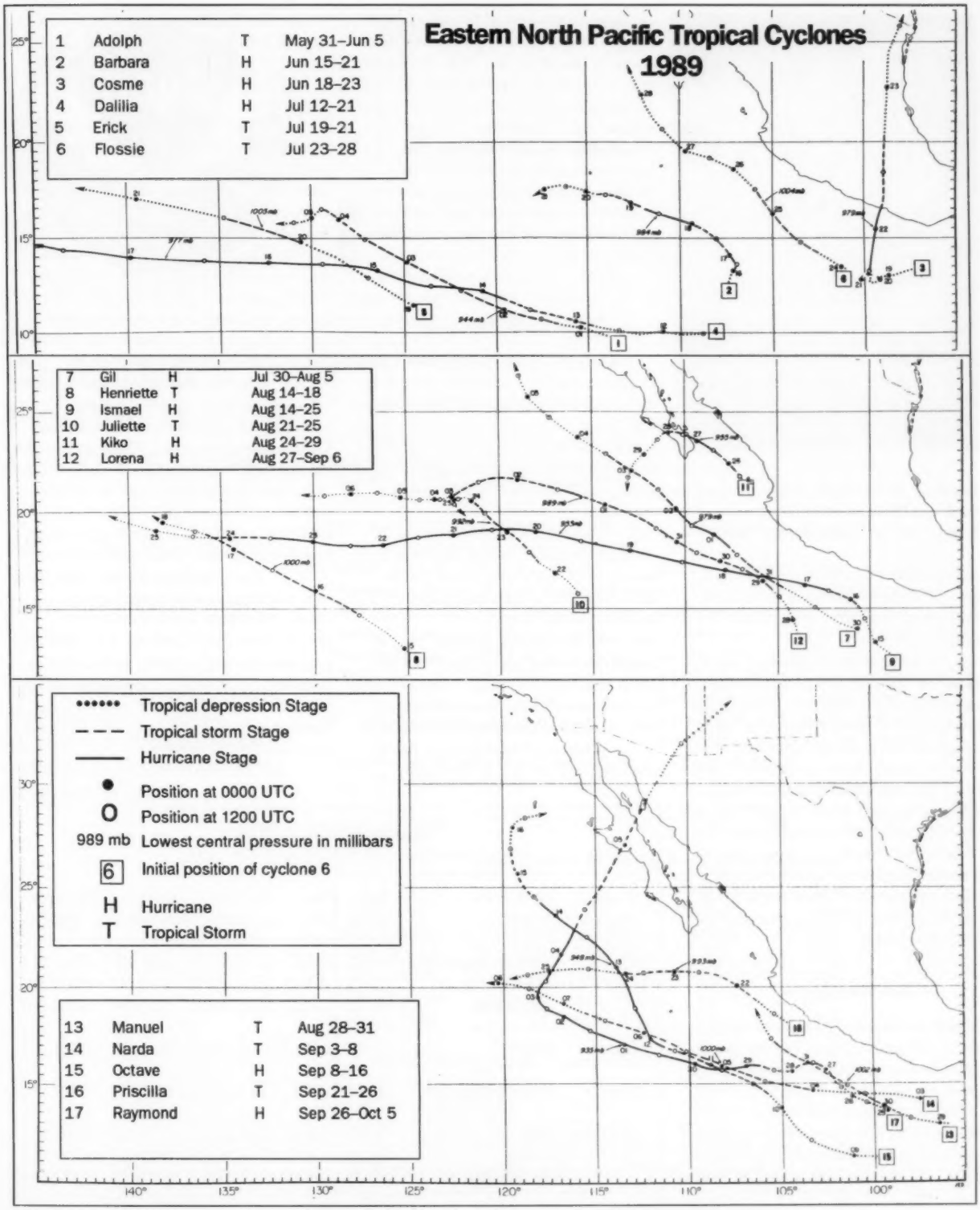
Hurricane Kiko is caught near the southern tip of Baja California at about 2230 on the 26th of August. The maximum sustained winds at the time were estimated at 105 knots. Kiko was the only home grown hurricane in the eastern North Pacific this year. All the rest were seedlings in the North Atlantic before being transplanted.

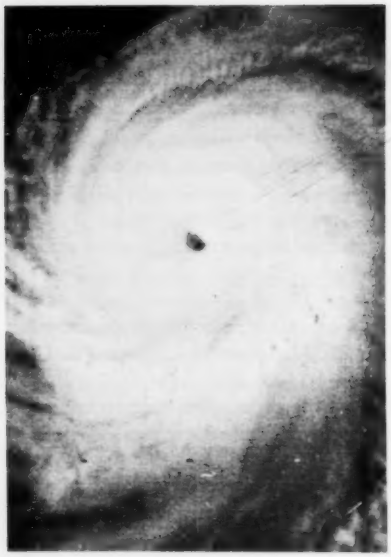
1989 Eastern North Pacific Named Tropical Cyclones

No.	Name	Class[1]	Dates[2]	Max. Wind 1-min (knots)	Min. pressure (mb)	Damage ($millions)	Deaths
1	Adolph	T	May 31–Jun 5	55	994		
2	Barbara	H	Jun 15–21	70	984		
3	Cosme	H	Jun 18–23	75	979		10
4	Dalilia	H	Jul 12–21	80	977		
5	Erick	T	Jul 19–21	35	1005		
6	Flossie	T	Jul 23–28	35	1004		
7	Gil	H	Jul 30–Aug 5	75	979		
8	Henriette	T	Aug 14–18	45	1000		
9	Ismael	H	Aug 14–25	105	955		3
10	Juliette	T	Aug 21–25	55	992		
11	Kiko	H	Aug 24–29	105	955		
12	Lorena	H	Aug 27–Sep 6	65	989		
13	Manuel	T	Aug 28–31	40	1002		
14	Narda	T	Sep 3–8	45	1000		
15	Octave	H	Sep 8–16	115	948		
16	Priscilla	T	Sep 21–26	55	993		
17	Raymond	H	Sep 26–Oct 5	125	935	1.5	

1 T: tropical storm, wind speed 39–73 knots
H: hurricane, wind speed 64 knots or higher

2 Dates begin at 0000 UTC and include tropical depression stage


Eastern North Pacific Tropical Cyclones
1989
1 Adolph T May 31–Jun 5
2 Barbara H Jun 15–21
3 Cosme H Jun 18–23
4 Dalilia H Jul 12–21
5 Erick T Jul 19–21
6 Flossie T Jul 23–28
7 Gil H Jul 30–Aug 5
8 Henriette T Aug 14–18
9 Ismael H Aug 14–25
10 Juliette T Aug 21–25
11 Kiko H Aug 24–29
12 Lorena H Aug 27–Sep 6
Tropical depression Stage
Tropical storm Stage
Hurricane Stage
Position at 0000 UTC
Position at 1200 UTC
989 mb Lowest central pressure in millibars
6 Initial position of cyclone 6
H Hurricane
T Tropical Storm
13 Manuel T Aug 28–31
14 Narda T Sep 3–8
15 Octave H Sep 8–16
16 Priscilla T Sep 21–26
17 Raymond H Sep 26–Oct 5
140°
135°
130°
125°
120°
115°
110°
105°
100°



Hurricane Raymond was generating 125–knot winds at 2200 on the 30th, making it the strongest hurricane of the season in this basin.

strengthened to a 65–knot hurricane on September 1st some 350 nautical miles west southwest of the southern tip of Baja California.

Lorena was a minimal hurricane for only 6 hours and then weakened to a tropical storm. It was downgraded to a tropical depression on the 3d about 700 nautical miles west southwest of the southern tip of Baja California. The ***Golden Grampus*** reported 42–knot easterly winds at 0000 UTC on the 30th some 180 nautical miles north of Lorena's center. Lorena passed directly over Socorro Island, where wind reports were below storm force, but the surface pressure dropped to 1000.2 millibars.

Hurricane Octave

Octave formed on September 8th, about 400 nautical miles south of Acapulco and as a depression it paralleled the coast of Mexico. It became a tropical storm on the 9th and a hurricane on the 11th. The hurricane's maximum intensity was estimated at 115 knots at 0000 UTC on the 13th, some 200 nautical miles northwest of Socorro Island.

When Octave passed south of Socorro Island on the 12th, the highest one–minute wind speed reported was 35 knots and the lowest pressure reported was 1003.6 millibars. Colder sea–surface temperatures and an increase in vertical wind shear over Octave caused weakening on the 14th and 15th. A circulation was last located on the 16th near Guadalupe before dissipating.

Hurricane Raymond

Raymond began on September 25th when a tropical depression formed to the south of Acapulco. It became Tropical Storm Raymond on the 26th. Raymond moved toward the northwest for 24 hours when high pressure developed to the north and the cyclone turned westward.

Raymond then continued strengthening over warm waters and was upgraded to a hurricane on the 28th. Satellite images eventually showed a distinct eye and a well–defined outflow pattern. Its estimated maximum wind speed was 125 knots at 0000 UTC on October 1st. This makes Raymond the strongest hurricane of the 1989 eastern Pacific season.

Raymond headed west northwestward and on the 2d the slowly weakening hurricane slowed and turned toward the northwest in response to a downstream trough. By the 3d Raymond had recurved toward Mexico.

While Raymond accelerated northeastward over cooler waters, vertical shear also increased, assisting the weakening. It was downgraded to a tropical storm by 1200 UTC on the 4th, and within the next 24 hours moved rapidly across Baja California and into the mainland Mexican state of Sonora. The mountains further weakened Raymond, resulting in a tropical depression being tracked across southeastern Arizona into western New Mexico.

On the 26th, the ***Lircay*** reported an east wind at 37 knots about 75 nautical miles northwest of the center. On the 27th, the ***Pacific Crane*** reported an east southeast wind at 35 knots some 100 nautical miles north of the center. A wind of 35 knots was reported at Guaymas at 0000 UTC on the 5th when Raymond was over the Baja Peninsula.

Flash floods were reported over portions of southeast Arizona, where maximum rainfall amounts ranged from 2 to 5 inches. The most extensive damage reports came from Nogales and Wilcox. There were no casualties in the United States and the damage estimate in southeast Arizona is placed at $1.5 million.

Tropical Cyclone Winds
(Ship encounters of 35 Knots or more)

Tropical cyclone	Ship Name	Date Mo/Da	Time UTC	Position LatN,LonW	Wind(kn) Dir/Speed	Pressure (mb)
Cosme	***Sammi Super Stars***	6/20	1800	14.5, 96.4	100/36	1012.0
	Toyofuji No. 10	6/21	1800	15.5, 97.8	090/43	1007.5
	Keystoner	6/22	0000	16.1, 98.4	120/55	1003.0
Flossie	SHIP	7/24	0600	11.5,104.0	220/39	1011.1
Lorena	***Golden Grampus***	8/30	0000	20.1,107.2	090/42	1007.0
Raymond	SHIP	9/25	1200	13.2,101.7	270/35	1007.2
	Lircay	9/26	1200	15.5,102.6	090/37	1007.0
	Pacific Crane	9/27	0600	17.7,103.2	120/35	1007.6

Central North Pacific Tropical Cyclones, 1989

A.K.T. Chun, R. T. Martin and H.E. Rosendal
Central Pacific Hurricane Center

Dalilia was the only tropical cyclone above tropical depression strength to be spotted in the central region this past season.

In a normal year, usually one tropical storm or hurricane will develop in central North Pacific waters. This is most likely from August through November. However, this season only two tropical depressions formed in July and a couple of outsiders moved through the region.

Tropical Depression Four–E

Tropical Depression Four–E developed east of the Central Pacific Hurricane Center's (CPHC) area of responsibility on July 9th. It crossed into the CPHC's area near 12.3°N,140.0°W moving in a west northwesterly direction at about 10 knots. Four–E remained a tropical depression the whole time that it was in the central Pacific and finally dissipated south of South Point, Hawaii, while moving westward along 15°N on the 14th.

Tropical Depression Five–E

Tropical Depression Five–E formed on July 12 in the same general area where Four–E came into being a few days earlier. Five–E first moved westerly and later toward the west southwest at an increased forward speed of 15 to 20 knots. It crossed into the Central Pacific Hurricane Center's (CPHC) area of responsibility near 11°N at 0000 UTC on the 14th, and dropped as far south as 9°N while weakening. The final advisory on a dissipating Five–E was issued by the CPHC at 2100 UTC the same day. Remnants moved westward and passed far to the south of South Point, Hawaii on the 16th.

Hurricane Dalilia

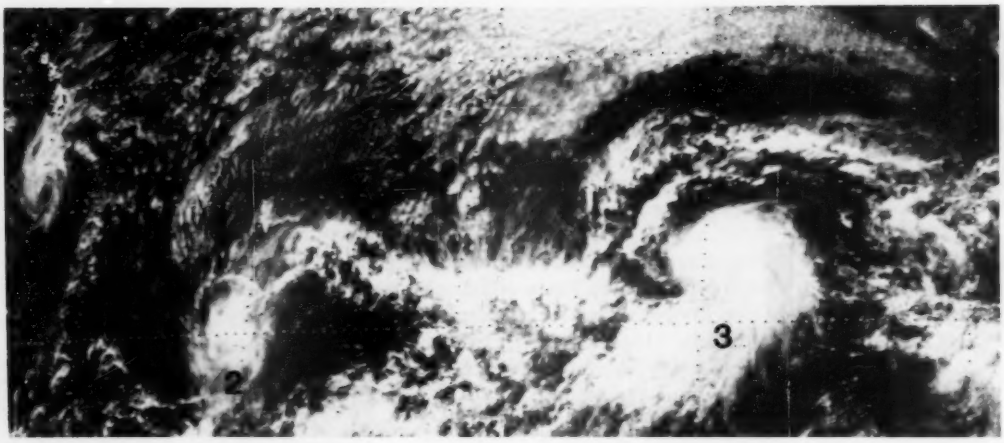
Hurricane Dalilia developed in the eastern Pacific on July 13. Dalilia moved slowly westward and crossed into the central region near 14°N at 0000 UTC on the 17th. Dalilia, moving west northwesterly, gradually increased its forward motion to near 20 knots and took aim at the Hawaiian Islands as a hurricane with maximum sustained winds of 65 knots.

Waves, generated by the strong

1989 Central North Pacific Tropical Cyclones

No.	Name	Class[1]	Dates[2]	Max Wind 1–min (knots)	Min. pressure (mb)
1	Four–E	Td	July 11–14	30	N/A
2	Five–E	Td	July 14–16	30	N/A
3	Dalilia	H	July 17–21	65	989[3]
4	Ismael	Td	Aug.24–25	30	N/A

1 Highest Classification in Central Pacific
Td: tropical depression, wind speed less than 39 knots
T: tropical storm, wind speed 39–73 knots
H: hurricane, wind speed 64 knots or higher
2 Dates begin when the tropical cyclone enters the central region.
3 Reconnaissance flown after system reached its peak.



Most of the action came in a bunch in mid July in the central North Pacific. Here on the 13th at about 2200, is (1) TD Four–E. (2) TD Five–E amd (3) Hurricane Dalilia, which is still in eastern waters. Below, left is Dalilia on the 17th at about 1800, with sustained winds of 65 knots.

easterly winds north of the center, moved along with the storm at a rate of 20 knots. This resulted in a concentration of the swell traveling in a narrow path along the direction of the storm motion and caused 10–to 15–foot surf along the Puna and Kau coasts of the Big Island of Hawaii. These waves arrived slightly ahead of the weakening cyclone as it passed less than 100 miles to the south of South Point, Hawaii at about 0300 UTC on the 20th.

Dalilia was downgraded to a tropical storm at 1800 UTC on the 19th. At 0600 UTC on the 20th its center was located by U.S. Air Force reconnaissance about 60 miles southwest of the Kau and South Kona coastlines, moving in a northwest direction paralleling the Hawaiian Island chain. Winds over land areas gusted to 40 knots at South Point and other spots in the Kau and South Kona districts. Wind damage was minimal, mostly in the form of downed trees and power lines.

Rainfall was heavy over the southeast slopes of Mauna Loa from South Point across the Volcano National Park and into the Puna district, where 6 to 9 inches of rain fell overnight between the 19th and 20th.

During the passage of Dalilia, the 24–hour rainfall recorded at Honolulu International Airport was 2.18 inches on July 20. The unusual nature of this heavy rain in July over the lowlands of Oahu can be seen in the fact that this the wettest July recorded, with a rainfall total of 2.33 inches. Honolulu's previous July record (records kept since 1947) was 2.01 inches in 1970.

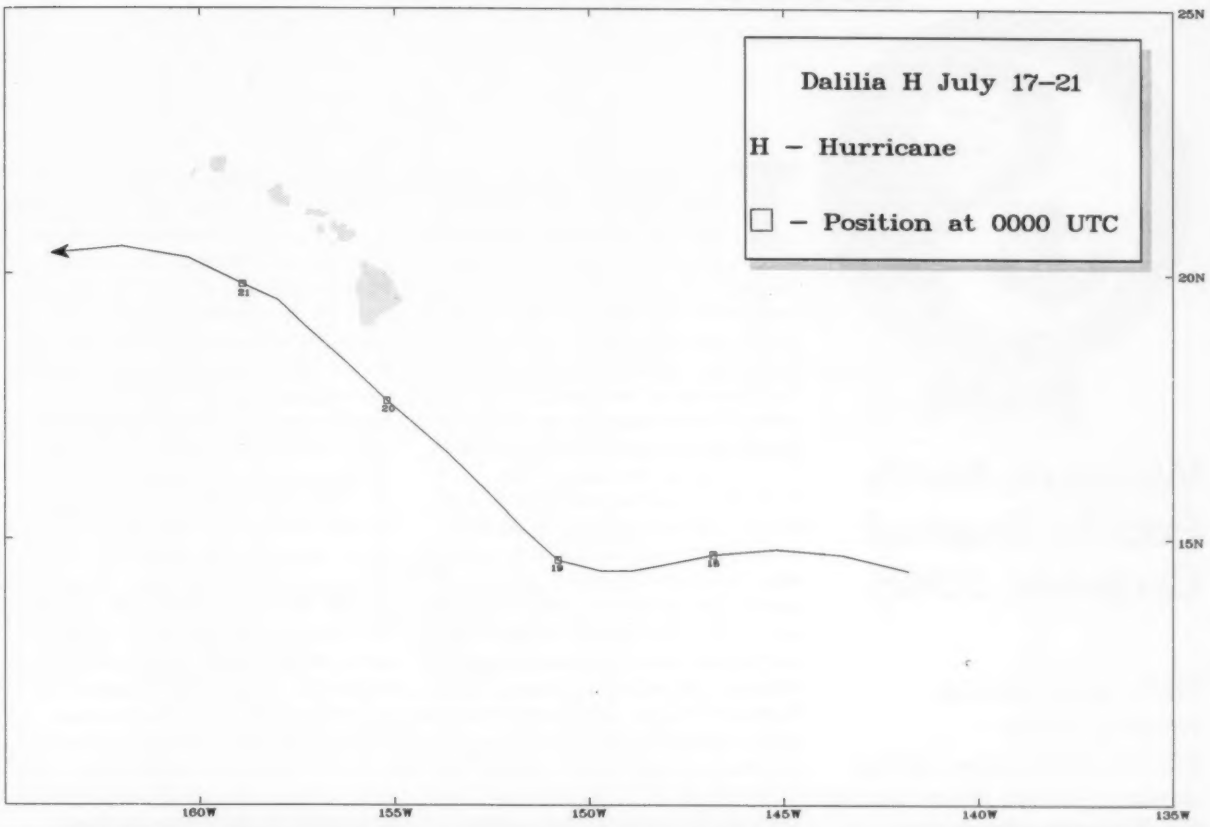
Dalilia weakened as it moved west northwestward away from the main Hawaiian Islands group and became involved with a cold core trough in the upper westerlies. The fast moving remnants of Tropical Storm Erick caught up to the dissipating circulation of Dalilia and the added moisture caused another burst of heavy rains, this time over the islands of Kauai and Niihau. The two islands were drenched on July 23 as 3 to 6 inches fell over the area and in particular the normally dry western areas of Kauai. Some amounts of more than 10 inches, with localized flooding, were reported.

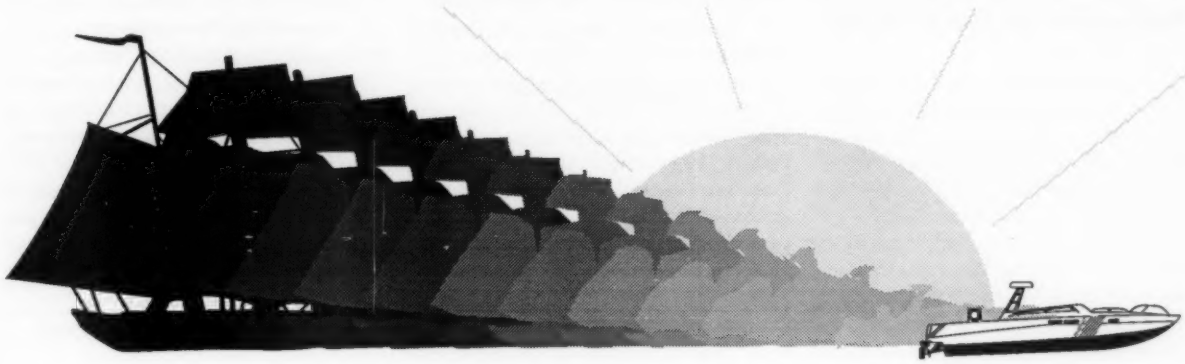
The remnants of Dalilia drifted west northwestward along the Northwestern Hawaiian Islands (Nihoa to Kure Atoll) and dropped some unusual heavy summer rains over French Frigate Shoals and other islets. These heavy showers plus the infusion of additional moisture from Erick led to the warming of the circulation and it regained some of its tropical characteristics on July 24 and 25 on approach to Midway Island and Kure Atoll. The rejuvenated cyclone may have reintensified into a tropical storm for a short period of time while recurving just east of Midway Island on the 26th and 27th. On the 28th, the remnants accelerated northward toward the Aleutian Islands.

Tropical Depression Ismael

Ismael was a rapidly weakening tropical storm when it crossed into the central Pacific near 19°N on August 25 at 0000 UTC. The Central Pacific Hurricane Center (CPHC) downgraded Ismael to a tropical depression with maximum sustained winds of 30 knots on its first advisory. Ismael continued to weaken as it moved westward at 10 knots. The last advisory on the dying depression was issued only 12 hours after it crossed into the CPHC's area of responsibility.

Central North Pacific Tropical Cyclones, 1989





200 Years of Service

1790 – 1990

United States Coast Guard

Western North Pacific Tropical Cyclones, 1989

Staff, Joint Typhoon Warning Center

Over the Philippines— Eleven tropical cyclones moved across the Philippine Islands this season and a severe typhoon made it into the Bay of Bengal.

The 1989 season was unusual in many regards. The variety of synoptic influences made it one of the most unique and challenging in the Joint Typhoon Warning Center's 30–year history. The monsoon trough was very active, even into November. Because the trough was broad and there were abnormally large diurnal fluctuations in convection, disturbances were slow to intensify above 30 to 40 knots. Several tropical cyclones stalled for prolonged periods of time. In fact, Jack sat 175 nautical miles directly east of Guam for nearly 2 days. An active Tropical Upper–Tropospheric Trough (TUTT) played a major role in the development, intensification and movement of numerous tropical cyclones. Of particular interest was Typhoon Gordon, which actually developed explosively from a thunderstorm that built beneath, and directly up into a cold–cored TUTT aloft. Finally, 1989 had a large number of very compact, yet very intense typhoons. The presence of Tropical Cyclone 32W (Gay) with super typhoon intensity in the Bay of Bengal was a rare occurrence.

January through June

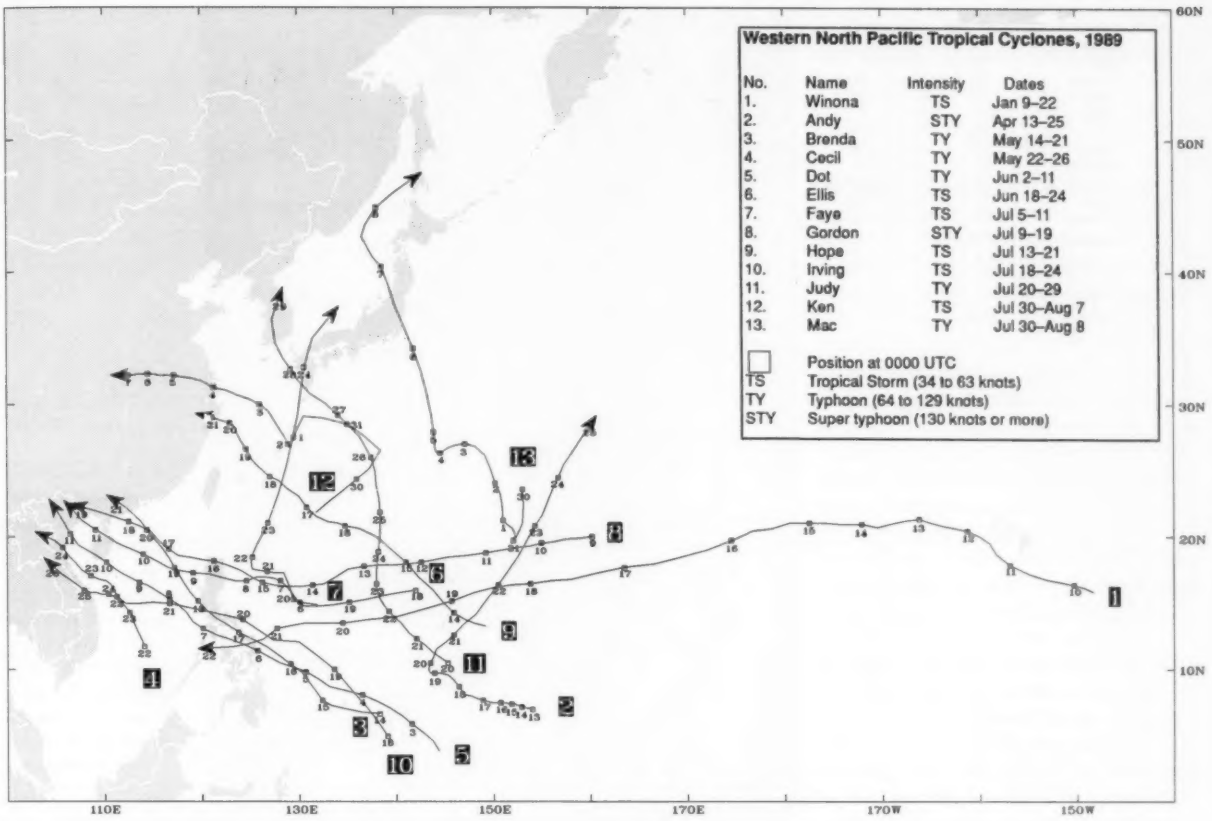
Winona, the season's first tropical cyclone, began quietly southeast of the Hawaiian Islands. The system was unusual because of its compact size and persistence. In 2 weeks it traveled over 5500 nautical miles before finally dissipating in the Philippine Islands. Following Winona, there was a long break in activity until mid–April when Super Typhoon Andy became the second typhoon in the past 9 years to form in April. It developed very slowly and, after recurving at the extremely low latitude of 10°N, passed 70 nautical miles southeast of Guam. A month later Brenda, the first of two May typhoons, came to life in the western Caroline Islands, moved northwestward across the central Philippines, and then made landfall in China. It was the second of eleven tropical cyclones to cross the Philippines during the year. Typhoon Brenda formed at the end of an extensive monsoon trough, which spread across the Bay of Bengal into the South China Sea. It moved northwestward and dissipated over southern China, leaving behind an area of enhanced low–level southwesterly flow. Typhoon Cecil developed in the South China Sea in the wake of this enhanced flow. After Cecil churned across the South China Sea and into Vietnam during the last week of May, the tropics were relatively quiet for 2 weeks. Then came Typhoon Dot, which formed in low latitudes south of the central Caroline Islands, moved steadily west northwestward, and crossed the Philippine Islands. It reached typhoon intensity in the South China Sea and eventually dissipated over northern Vietnam. The second June storm, Tropical Storm

Monthly Summary of 1989 Western North Pacific Tropical Cyclones

	Jan	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Tropical depressions					1	2				1	4
Tropical storms	1			2	4	1	2				10
Typhoons			2	1	2	2	4	2	2	1	16
Super typhoons*		1			1		1	1	1		5
Totals	1	1	2	3	8	5	7	3	3	2	35

*Super typhoon Winds of 130 knots or greater

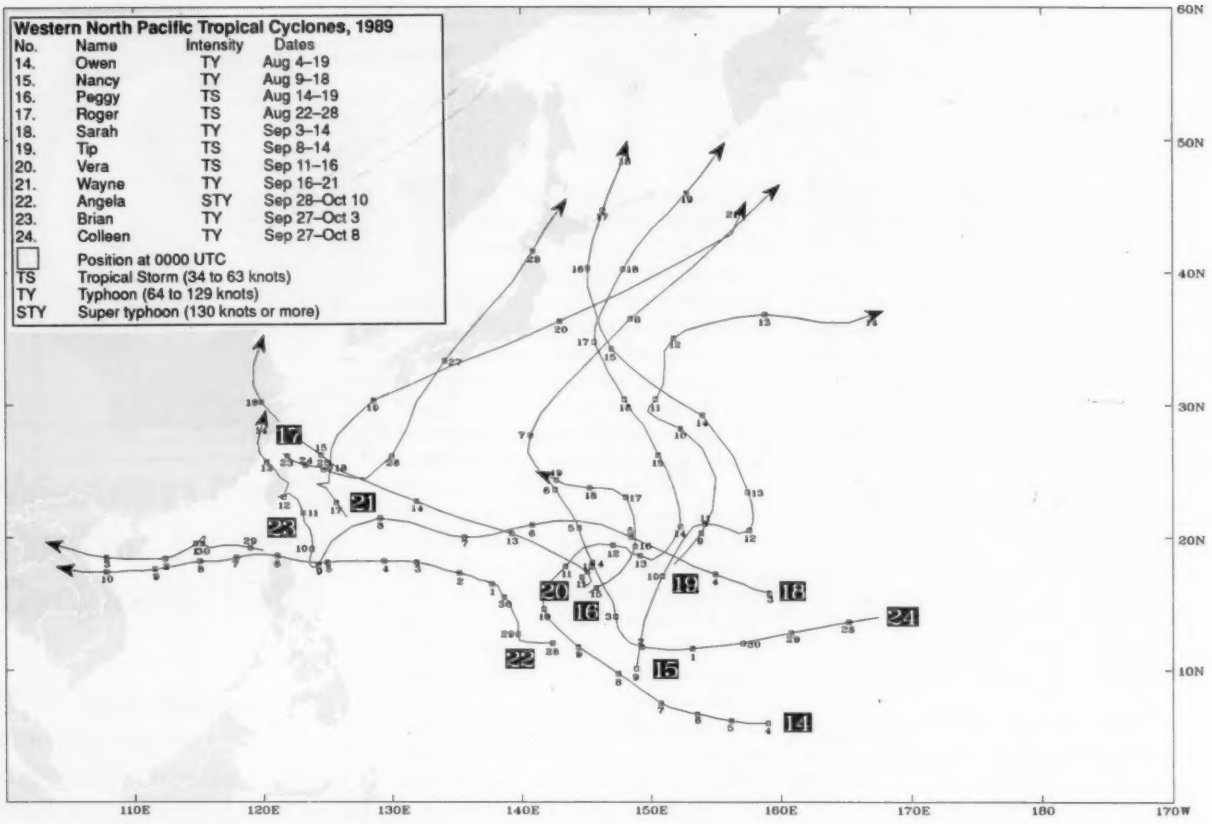
This is an excerpt from the Joint Typhoon Warning Center Annual Report. Frank Wells was instrumental in preparing and submitting this summary.



Ellis, interrupted the series of *straight runners* that occurred from Brenda through Dot. The asymmetric displacement of a broad area of gale force winds, away and to the east of the low–level circulation center, accompanied Ellis. After 5 days as a poorly defined system, Ellis briefly peaked at tropical storm intensity before becoming extratropical and making landfall in Japan.

July

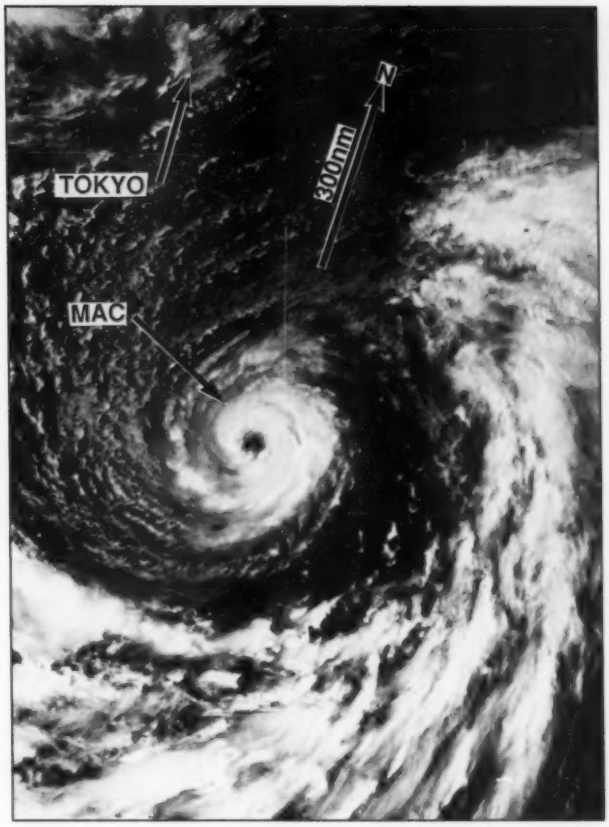
After another 2–week break in activity, a surge in the southwest monsoon caused widespread convective activity in the area west of the Mariana Islands, culminating in the genesis of Faye, the first of eight tropical cyclones to form in July. Faye intensified at a normal rate as it tracked west northwestward toward the Philippines. The cyclone weakened as it crossed north–central Luzon and reintensified slightly in the South China Sea. It weakened again in the central South China Sea, and crossed the island of Hainan before making landfall on the coast of northern Vietnam. At the start of the second week of July, while Tropical Storm Faye was affecting the Philippine Islands and the Tropical Upper–Tropospheric Trough (TUTT) was influencing weather near Wake Island, the second super typhoon of the year, Gordon, developed. It was unique in that it developed from a single cumulonimbus directly beneath a cyclonic cell in the TUTT. The cumulonimbus was initially small, but underwent a dramatic rapid, almost explosive, deepening phase. Hope generated in the wake of Gordon but failed to develop to typhoon intensity as a result of the upper–level shear caused by the outflow from Super Typhoon Gordon. During its life, Hope moved generally northwestward, occasionally *stair–stepping* in response to the passage of a series of mid–latitude short–wave troughs. Although no binary interaction was apparent, the tropical cyclone tracked along the periphery of Gordon's low–level circulation for most of its lifetime. As Super Typhoon Gordon was about to make landfall on the coast of China and Tropical Storm Hope was reaching peak intensity, Irving formed in the monsoon trough near the southwestern Caroline Islands. Tropical Storm Irving was the fourth tropical cyclone of 1989 to cross the South China Sea, but the last until Typhoon Brian late in September. Irving was short–lived and actually reached its maximum intensity as it made landfall on the coast of northern Vietnam. The day after Irving came to life, Judy devel-



oped in the monsoon trough just west of Guam. Judy followed a northward–oriented track with a critical turn to the northwest, just to the south of Honshu. It brushed the southern coast of Kyushu, made landfall on the south coast of the Korean Peninsula and dissipated rapidly. While Typhoon Judy was tracking northwestward toward Korea, an associated area of deep convection became persistent to the south southeast in the monsoon trough that had already proven itself the most active since July 1973. The disturbance became Ken–Lola, which took an elongated cycloidal track, passing close to Okinawa before making landfall on the coast of eastern China. JTWC considered the system as two separate tropical cyclones but a detailed post analysis, strongly suggested that Ken and Lola were most probably the same system. Tropical Storm Ken–Lola underscored the limitations of remote sensing for locating some poorly organized systems. Synoptic data proved invaluable in identifying and classifying the system while in warning status and in post analysis.

August

As the most active July since 1973 came to a close, Judy was dissipating over Korea and Tropical Storm Ken–Lola was threatening Okinawa. During this time, Mac developed northeast of Saipan in an extremely active monsoon trough. Typhoon Mac also developed at a higher than normal latitude. In addition, its track and intensity were influenced by a complex mid–latitude synoptic regime complicated by a multi–storm environment. The typhoon had a general northwesterly track, interrupted by 48 hours of westward movement before it resumed a northerly motion, and made landfall east of Tokyo. Mac weakened rapidly as it moved across the Sea of Japan and dissipated over southern Sakhalin Island. Soon thereafter, Typhoon Owen slowly spun up in the monsoon trough while moving on a general northwestward to northward track. Due to the proximity of Nancy, which developed at the extreme eastern end of the monsoon trough and was intensifying to the east, Owen took more than a week to reach tropical storm intensity. Later, 3 days of binary interaction with Typhoon Nancy resulted in an unusual southeasterly track during its developing stage. Then the tropical cyclone followed Nancy through recurvature and extratropical transition into high latitudes. The third tropical cyclone to develop in the monsoon trough was Peggy. Although there was a brief



At peak intensity Mac (right) is surrounded by a ring of subsidence. The DMSP visual image was taken on August 3d at 2304 UTC. Below right Typhoon Angela is generating winds of 115 knots on the 2d of October at around 0100 UTC.

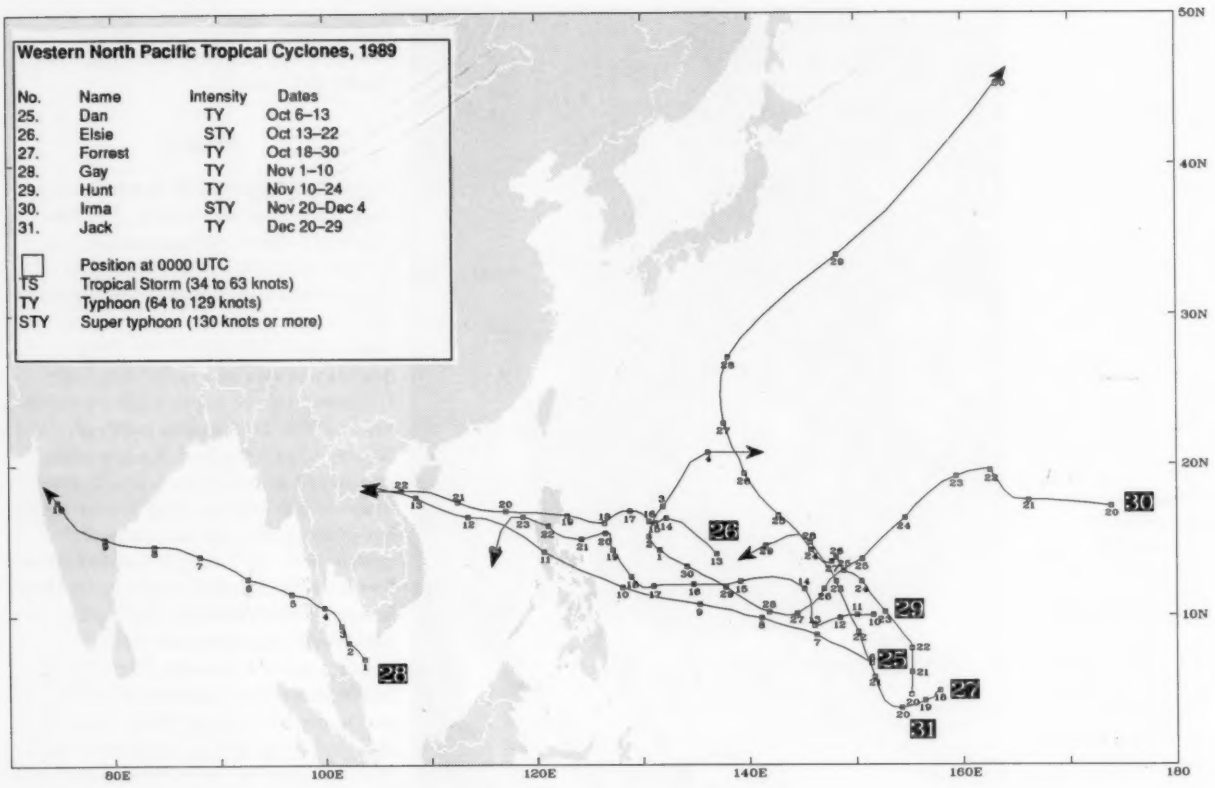
interaction with Owen, Peggy was short–lived and only reached minimal tropical storm intensity. Forming just north of Taiwan, Roger moved southeastward into the southern Ryukyu's, abruptly turned northeastward, and made landfall on Honshu.

September

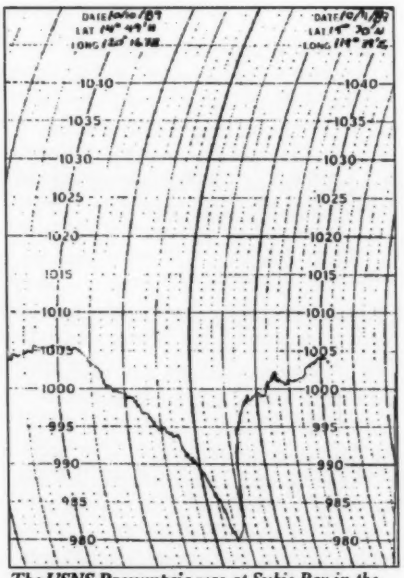
The first of the September tropical cyclones, Sarah, apparently underwent a binary interaction with a secondary low east of Luzon and later, when it stalled east of Luzon, was involved with the development of a sympathetic low on the lee side of Luzon. From genesis involving two distinct cloud masses to accelerating toward the Philippines, stalling just east of Luzon, moving north and rapidly reintensifying, then looping over eastern Taiwan, Sarah was one of the most difficult storms of the year to forecast. Sarah finally moved northwestward across northern Taiwan and dissipated in China. Generating in early September at the eastern end of the monsoon trough, Tip executed an unusual track to the northeast, then recurved around the subtropical ridge, and finally tracked eastward with the polar westerlies. Tropical Storm Tip reached its peak intensity at 37°N, 2 days after recurvature. Developing in the monsoon trough north of Guam, Tropical Storm Vera, after some initial erratic motion, moved on a west northwestward track, threatened Okinawa, and made a devastating landfall just south of Shanghai. About 24 hours after Vera had dissipated, the first warning on Wayne was issued. Typhoon Wayne was the last tropical cyclone of 1989 to affect Japan. It was unique in that it intensified after recurvature, partly as a result of its rapid acceleration. Wayne caused considerable destruction, mudslides and some deaths in Japan.

October

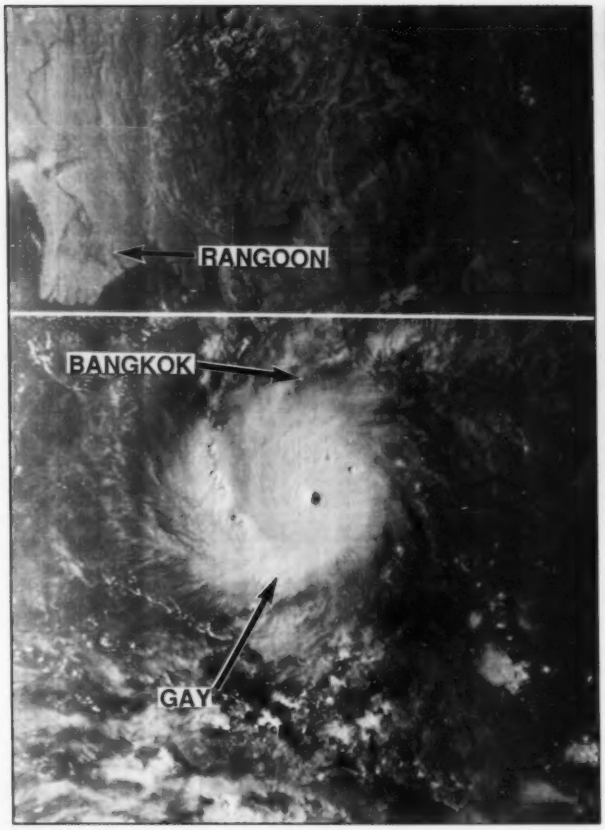
During late September the monsoon trough became very active. The first storm of a three–cyclone outbreak in 3–days, Angela had the distinction of being in warning status longer than any other tropical cyclone in the western North Pacific this year— 12 days. Angela was also one of five tropical cyclones to reach super typhoon intensity in 1989. Developing south of Guam, Angela tracked slowly westward and struck northern Luzon with super typhoon intensity, causing a large number of casualties and widespread destruction. It then reintensified in the South China Sea and finally made landfall in central Vietnam. As Angela developed, the monsoon trough became active across the South China Sea from western Luzon to Vietnam and spawned typhoon Brian. Cecil in May and Brian in late September–early October were the only tropical cyclones to develop and spend their entire lifetimes within the confines of the South

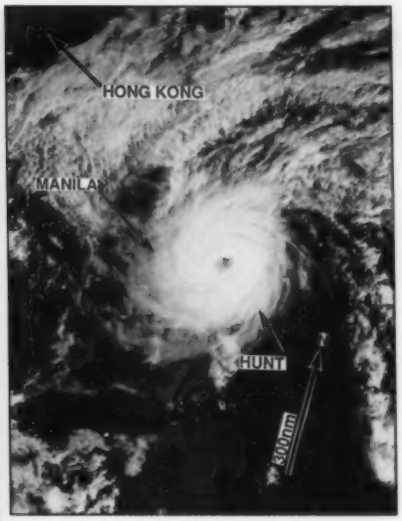


China Sea. Nearly 4000 nautical miles to the east, a deep trough penetrated the tropical western North Pacific near the dateline and Colleen formed at its base. Colleen passed through the northern Mariana Islands before recurving south of Japan. It maintained typhoon intensity until it turned extratropical, threatening PACEX 89—the largest U.S. Navy exercise conducted in the Pacific since the Korean War. Forming from a disturbance in the monsoon trough near Truk, Dan followed a steady west northwestward track and crossed the central Philippine Islands. Coming just days after Typhoon Angela's destructive passage across northern Luzon, Dan added to the misery. The cyclone reintensified in the South China Sea and made landfall on the coast of central Vietnam where it caused more destruction. In the wake of Angela and Dan, Super Typhoon Elsie became the third tropical cyclone to hit the Philippine Islands within 12 days. Elsie developed from a TUTT–induced wave in the easterlies and tracked westward throughout its life. In the Philippine Sea, Elsie rapidly intensified and struck central Luzon with an intensity of 140 knots. It was cited as the most intense cyclone to strike the Philippine Islands this year. Because of its small size, Elsie weakened dramatically as it moved across the Philippines, and did not reintensify as it traversed the South China Sea. The cyclone dissipated after making landfall in central Vietnam. The last of six October tropical cyclones, Forrest was slow and erratic in its development. Throughout its early life, Forrest was a sloppy, broad system. After passing Guam, it finally intensified and ultimately became a respectable 95–knot typhoon. Soon thereafter, it recurved



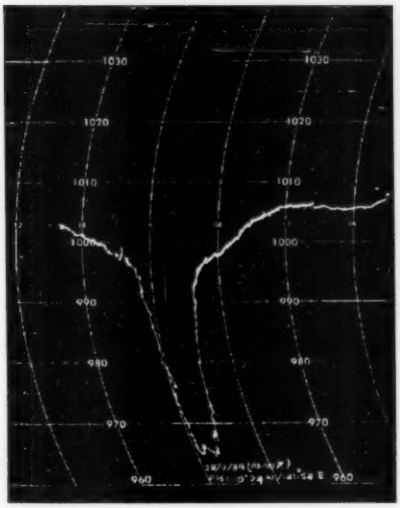
The USNS Passumpsic was at Subic Bay in the Philippines when typhoon Dan went through on October 10th, as their barograph shows.





Typhoon Gay (right) makes landfall on the Malay Peninsula on November 4th at 0042 UTC. More than 1000 people were reported dead or missing in Gay's aftermath. This was the worst storm to affect the Malay Peninsula in 35 years. The photograph is a NOAA visual image. Below is a view from the bridge of the ***M.V. Goldensari Indah,*** *which sailed through Typhoon Irma on the 28th of November at about 0000 UTC. At far right Typhoon Hunt poses for a portrait about 9 hours before landfall over central Luzon. The DMSP visual image was made at 1130 UTC on the 21st of November.*

and accelerated rapidly to the northeast becoming one of the year's strongest extratropical cyclones.



November through December

The first tropical cyclone of November turned out to be the worst tropical cyclone to affect the Malay Peninsula in 35 years. Gay generated in the Gulf of Thailand, sank numerous ships, crossed the Malay Peninsula into the Bay of Bengal and slammed into India with peak sustained winds of 140 knots. Unique because of its small size, great intensity, and point of origin, Gay crossed two different tropical cyclone basins and almost entered a third. Except for Typhoon Gay, early November was relatively inactive in the western North Pacific. In mid–November, Hunt initially appeared as a weak tropical disturbance in the monsoon trough. Hunt was the fourth typhoon to strike the Philippine Islands within 6 weeks. Generally a westward moving system, Hunt was slow to develop, but intensified rapidly in the western Philippine Sea. As it approached the Philippines, the cyclone underwent a *stair–step* move before resuming a westward course into central Luzon. Unlike its predecessors, Hunt dissipated in the South China Sea after crossing Luzon. Irma was the third and final tropical cyclone to form in November. It's development and track were dictated by complex mid–latitude and monsoonal regimes. Initially, Irma was slow to develop, however, rapid intensification followed once it entered in the Philippine Sea. As Super Typhoon Irma weakened in the Philippine Sea, Tropical Depression 35W was detected on the first day of December in the western Marshall Islands. The depression lasted more than a week as a discrete system. The second tropical cyclone to form in December, Jack was the twenty–first tropical cyclone of the year to attain at least typhoon intensity, and was the final tropical cyclone of the season. Typhoon Jack was noteworthy for the unusually long period it remained stationary. Not surprisingly, the unusual motion of Jack was accompanied by an equally unusual intensification and dissipation pattern. The cyclone rapidly intensified from 30 to 125 knots in 3½ days, then fell apart completely. In this remarkable dissipation, Jack's maximum winds dropped from 105 to 30 knots in 24 hours.

Memorable Lighthouse Storms

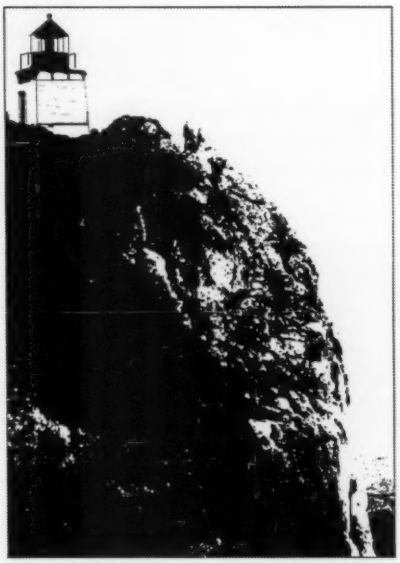
Elinor DeWire
Mystic Seaport Museum
Mystic, CT 06355

Despite an unusually high surf, the cargo-laden, five-masted schooner ***Bianca*** sailed out of Honolulu in 1927 on its way to the Far East. It would take about a week to reach the Orient, but the ship was not to see her destination. Unknown to her captain, the rough surf was a sign that a severe storm was bearing down on the Hawaiian Islands. By the time the Bianca rounded the southwestern tip of Oahu at Barbers Point, winds were ripping her sails apart, and her deck was awash. Dangerously near the reef, the skipper ordered all anchors dropped, but wind and sea drove the weakened ship shoreward.

From the lantern room of Barbers Point Lighthouse, Manuel Ferriera spotted the Bianca in trouble and sent a call for help. This was no easy task, since the storm was raging wildly around the lighthouse and the nearest telephone was 3 miles away. Ferriera had no automobile or horse, but this didn't detain him. Leaving the beacon in the care of his assistant, he ran through the driving rain and wind to telephone the steamship docks in Honolulu. The ***USS Sunidan*** was dispatched immediately, reaching the Bianca before she foundered on the reef.

Pacific storms are among the most awesome spectacles of natural power. Lighthouse logbooks at St. George Reef, the Farallones, Tillamook, and Cape Flattery are replete with fantastic storm reports. Enormous stones have been hurled against these towers; acres of their shore-front have been taken away in a single night; vessels have piled up at their feet; and personnel have gone to their deaths keeping the beacons lit.

One of the most powerful West Coast storms occurred in the winter of 1914 and slammed the Northern California coast with monster waves. Keeper Fred Harrington of Trinidad Head Light Station, some 20 miles north of Humboldt Bay, reported heavier seas than he'd ever seen in his 26 years as a lightkeeper. At the height of the storm, he saw waves crashing



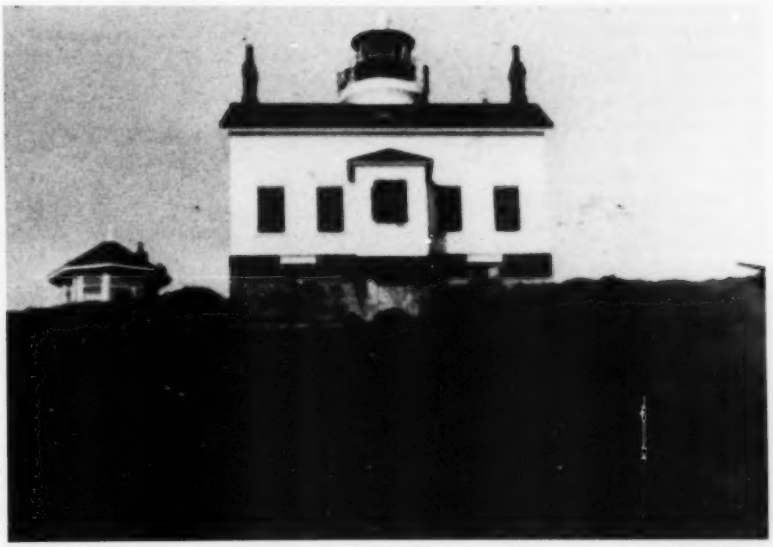
National Archives

This view of Trinidad Head Light Station, around the turn of the century, gives an appreciation for the size of the wave that Keeper Fred Harrington experienced. The lighthouse is some 180 feet above the sea; the point between the tower and the bluff was buried in water.

over 103–foot high Pilot Rock, just offshore. But the worst was yet to come. As Harrington prepared to light up the tower late in the afternoon on the storm's third day, he saw an immense wave approaching the cliff on which the lighthouse was perched, some 180 feet above the sea. In his own words:

"When it struck the bluff the jar was very heavy, and the sea shot up the face of the bluff and over it, until solid sea seemed . . . to be on a level with where I stood in the lantern. The sea itself fell over the top of the bluff and struck the tower on the balcony, making a terrible jar. The whole point between the tower and the bluff was buried in water. The lens immediately stopped revolving and the tower was shivering from the impact for several seconds." Harrington was lucky; he survived, and the lighthouse sustained very little damage.

The keepers of Decros Point Light Station in Texas were not so fortunate. Gulf Coast hurricanes have destructive reputations, due to the merciless storm surge that purges the Gulf's low, flat beaches of both life and property. Decros Point Light Station consisted of two screwpile towers when it was established in 1872 to mark the outer boundary of busy Pass Cavallo. Three years later, when a hurricane laid waste to much of the area around Matagorda Bay, both towers were leveled and all four of their keepers went to watery graves.



Jack Hettinger Collection

This rare view of the Willapa Bay Lighthouse (above) was taken in 1940 before it slid into the river. The light was originally established on October 1, 1858 and has been washed away several times in the course of its history. On December 22, 1940 the light was moved to a skeletal tower some 380 yards from the previous location. On the 26th the old structure began to slide and 4 days later it was carried away. Its last relocation was on June 9, 1986.

U.S. Coast Guard

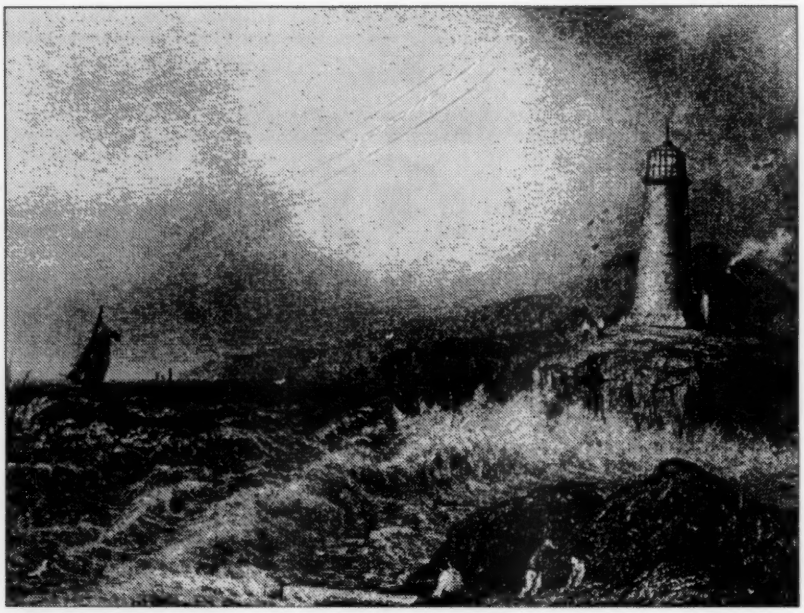
In 1893 a small but violent hurricane passed between New Orleans and Port Eads on October 1. The storm was accompanied by what was reported to be a tidal wave (storm surge), which engulfed everything before it and was responsible for the loss of an estimated 2,000 people. The Chandeleur Light Station (Louisiana) above was severely damaged and had to be replaced by the present iron–skeleton structure.

The tall, cast–iron Matagorda Lighthouse, serving as a landfall beacon for the region, also suffered in this same storm. "The water rose to an unusual height and stood some 4 feet deep in the tower," the logbook read. Everything at the station was swept away but the tower itself, in which the near–crazed keeper and his family had taken refuge. In the great Gulf Storm of September 1900, Bolivar Point Light at Galveston Bay reeled miserably in the 120–mph winds. Keeper Harry Claiborne saved 125 people from the storm surge by lodging them at the station until they could find shelter elsewhere.

Many Atlantic Storms have damaged or destroyed lighthouses entirely.

Fifteen years later, another corkscrew of devilish wind and rain slammed the North Texas Coast. Even more people took refuge at Bolivar Lighthouse this time, since it was the tallest structure in the area. Claiborne served as keeper of the light in the real sense and in the hearts of the frightened horde that huddled on the tower's circular stairs. He reported that the lighthouse "shook and swayed like a giant reed," but stood its ground valiantly. Before the storm waters receded they had risen to the shoulders of the lowest person on the lighthouse stairs!

Many Atlantic storms have damaged or destroyed lighthouses entirely. Matinicus Rock Light was



New England storms have destroyed more lighthouses than all others combined. Above is Mt. Desert Island Light Station, Maine, as depicted in an 1839 engraving. It has taken its share of beatings over the years.

torn down by the 1851 hurricane as it spewed its final furious gusts in the Gulf of Maine. Delaware's Cape Henlopen Light collapsed in a 1926 storm after a long struggle with beach erosion. And more recently, historic Great Point Light on Nantucket— one of the oldest in the nation— fell in a 1984 Nor'easter. Fortunately, no one was killed in any of these disasters.

Mabrity was forced to abandon her watch and flee the crumbling Key West tower before the storm had passed.

The tall, brick sentinel at Florida's Sand Key, however, took its occupants to their deaths in the hurricane of 1846. Built 20 years earlier on an exposed, unstable islet made of coral covered by sand, it disappeared completely during the storm and forced the U. S. to develop more durable designs for the storm–ravaged Florida Keys. The rapidly moving cyclone had left Havana in ruins and took South Florida by surprise. Key West lightkeeper Beryl Mabrity kept watch in her lantern room during the storm for the distant beam of Sand Key Light, 9 miles offshore. Her friend and colleague, widow Rebecca Flaherty, was out on Sand Key alone with her five children. Mabrity was forced to abandon her watch and flee the crumbling Key West tower before the storm passed. The next morning, when she scanned the horizon for Sand Key Light, it was gone. Rebecca Flaherty and her children had all drowned— the worst station fatality in U. S. lighthouse history.

A century later Florida's Jupiter Inlet Lighthouse survived the fierce 1928 hurricane, though the tower was badly damaged and the stamina and faith of its keeper were tested. The tower's new electrical system failed shortly after the storm's arrival. Franklin Seabrook, the headkeeper's 16–year old son, turned the huge lens by hand for nearly 48 hours until his father was able to repair the generator.

During this time wind and rain broke through one of the lantern room windows and shattered a bullseye on the tower's expensive French lens. But young Franklin hardly missed a step! After the storm was over Keeper Seabrook collected the shards of broken lens and shipped them to the depot in Charleston where they were painstakingly braced in a metal framework. The panel was returned to the tower and the lens put back in service. It still operates today.

New England storms have destroyed more lighthouses than all others combined, probably because sentinels have stood watch longest over our Yankee shores and outnumber lighthouses in other areas. Hardly a beacon between Long Island and Nova Scotia has not seen death or damage from storms. The worst, by far, occurred in the infamous hurricane of 1938.

He was one of the few New England lightkeepers whose beacon remained lit in the wake of the hurricane of 1938.

Keeper Arthur Small and his wife Mabel were tending Palmer Island Light when the angry September storm swept inland west of their picturesque New Bedford home. Arthur was washed off the island by a huge wave and pummeled with debris until he fell unconscious. His wife attempted to launch the station dory to rescue him, but the boathouse was smashed by 120–mph winds as she entered it. Mabel's body was never recovered, but Arthur amazingly survived a horrid journey across New Bedford Harbor in the storm surge. He washed ashore more dead than alive, was taken to a hospital, and lay comatose for weeks. He awoke to the sad news of his wife's death and the total destruction of Palmer Island Lighthouse.

The devastating late March gale of 1984, sank a tug on Lake Ponchartrain and triggered 22 tornadoes over the Carolinas on the 28th, leaving 57 dead and thousands injured. It then blasted New England leaving the Great Point Light (left) on Nantucket Island in a pile of rubble and blew aground the 473–ft freighter Eldia at Nauset Beach on Cape Cod, Massachusetts.

H. Flint Ranney

At Prudence Island Light in Narragansett Bay, five people were drowned when the storm carried away the lightkeeper's dwelling. The keeper himself was wrenched from the house and returned to shore unharmed in a freak backdraught of sea.

Another survivor thrown ashore by the hurricane— though it would probably have preferred staying in the water— was the Lighthouse Tender ***Tulip***, which carried supplies to all the lighthouses in Long Island Sound. The vessel was moored at New London, Connecticut, on the day the storm hit. It was lifted up by the tidal surge and left high and dry on the railroad tracks by the dock.

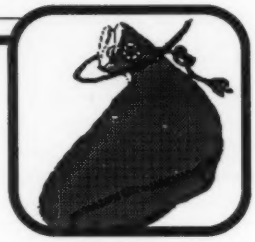
Keepers at Watch Hill and Point Judith lighthouses saw their popular resort communities leveled. But their sturdy towers, though darkened by power loss, stood firm. By the time the storm reached the Massachusetts North Shore, it had lost some of its punch. The beacon at Marblehead went out when the storm tore loose the lantern's electrical wiring. Keeper Harry Marden cleverly pulled his car alongside the tower and rigged an electrical connection to the battery. He was one of the few New England lightkeepers whose beacon remained lit in the wake of the hurricane of 1938.

Unable to see the beam of the lighthouse, the skipper began blowing the mailboat whistle repeatedly as a call for help.

A happier ending to a storm story comes from scenic Owls Head Lighthouse on a little promontory near Rockland, Maine. It was here that one of lighthouse history's most famous dogs lived— a friendly springer spaniel named Spot. The dog's penchant for ringing the old–fashioned fogbell amused many visitors to the lighthouse. One stormy night it even saved a life.

As the mailboat was returning from Matinicus Island one evening in the 1940s, a heavy snowstorm blew in. By the time the skipper of the mailboat reached Owls Head, driving snow had reduced visibility to zero. Unable to see the beam of the lighthouse, the skipper began blowing the mailboat whistle repeatedly as a call for help. Inside the keeper's house at Owls Head Spot heard the whistle and whined to be let out. His owners, who could hear nothing over the din of the storm, assumed mother nature to be urgently calling the dog and released him into the blizzard. Leaping over snowdrifts, Spot climbed to the fogbell and tried to sound it by yanking on the clapper rope. Snow lay so deep, however, the bell gave only a muffled hum. Determined to answer the whistle, Spot ran down to the edge of the water and began barking. The mailboat skipper heard the dog and veered away from shore, saving his boat from a sure collision with the rocks.

Hours later after the mailboat was safely anchored in Rockland and Spot lay asleep by the wood stove, the mailboat skipper called the Owls Head Lighthouse to thank the keeper for his "dogged" efforts. It was the first Spot's owner knew of his dog's bravery. When Spot died some years afterward the keeper buried him beneath his beloved fogbell.



A Note from Vanuatu

REPUBLIC OF VANUATU

VANUATU METEOROLOGICAL SERVICE

Private Mail Bag 54, Port Vila

VMS

As an avid reader of the Mariners Weather Log I was interested to read the article "What's in a Name?" in Vol. 33, No. 4 particularly since it mentioned the differences in tropical cyclone terminology. You have, however, not quite got the story correct as regards the South Pacific area.... Your article gave the impression that we only called systems tropical cyclones when they reached 64 knots or more [See definitions that follow]... I agree that the terms are confusing and do sometimes cause us problems. We do have people here who pick up information from either Guam TCWC or Honolulu PHNC. Bulletins containing phrases like "a tropical cyclone is approaching Port Villa" can cause anxiety and confusion here, especially if the system is really only a below gale force tropical depression. I repeatedly have to warn such people against listening to foreign weather reports because the terms may not be the same as from our own National Weather Service or the Nadi RSMC.

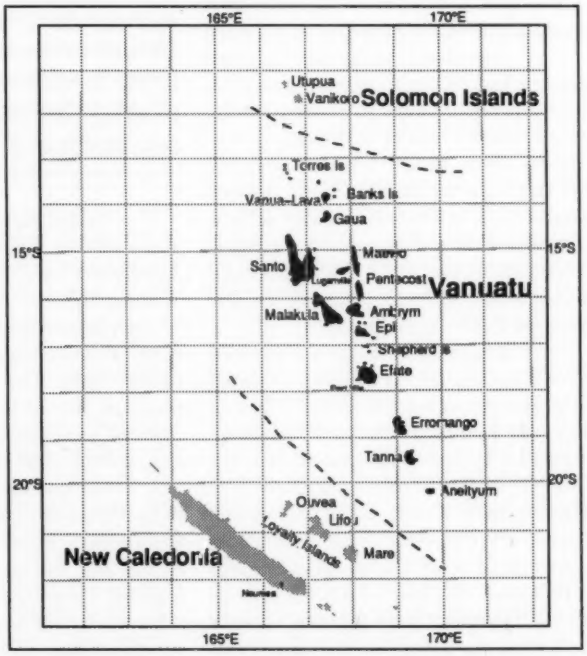
Yours Sincerely,

Mike Longworth
Director, Vanuatu
Meteorological Service

This important letter(excerpts)from Mike gives me the opportunity to spell out the definitions from each region according to the World Meteorological Organization (WMO). The WMO has accomplished much to standardize tropical cyclone terminology. It is necessary to remember that these terms cannot be completely standardized because local custom is often more important when warnings are concerned, as Mike points out. Mike also brought to my attention the fact that, although we use Vanuatu in the summaries, New Hebrides appears in the charts. New Hebrides hasn't existed since July 30, 1980. At that time it became the new independent Republic of Vanuatu. Thanks for this geography lesson, Mike. Although the charts are not ours, we still should have caught the discrepancy. I apologize for the slight.

The definitions of tropical terminology are, for the most part, those of the WMO. In some cases we included those used by the Joint Typhoon Warning Center. Howard April, of the International Affairs Branch of the National Weather Service, was invaluable in finding the most up-to-date tropical cyclone operational plans for the various regions.

—ed.



Tropical Cyclone Terminology

South Pacific Ocean

Tropical disturbance— A non–frontal synoptic scale low pressure area originating over the tropics with enhanced convection and/or some indications of cyclonic wind circulation.

Tropical depression— A tropical disturbance in which the central position can be identified and the average wind surrounding the center is below gale force (34 knots).

Tropical cyclone— A non–frontal cyclone of synoptic scale developing over tropical waters and having a definite organized wind circulation with average wind of 34 knots (63 km per hour) or more surrounding the center.

Hurricane— A tropical cyclone with hurricane force winds (64 knots or more).

Southwest Indian Ocean

Tropical disturbance— A non–frontal synoptic–scale low pressure area originating over tropical waters with enhanced convection and/or some indications of cyclonic wind circulation.Tropical storm— A non–frontal, synoptic–scale low pressure area originating over tropical waters with organized convection and definite cyclonic wind circulation.

Tropical depression— A tropical storm with wind estimated to be not exceeding 33 knots (61 km per hour or less).

Moderate tropical depression— A tropical storm in which the maximum of the average wind speed is estimated to be in the range of 34 to 47 knots (62 to 88 km per hour).

Severe tropical depression— A tropical storm in which the maximum of the average wind speed is estimated to be in the range of 48 to 63 knots (89 to 117 km per hour).

Tropical cyclone— A tropical storm in which the maximum of the average wind speed is estimated to be in the range of 64 to 90 knots (118 to 165 km per hour).

Intense tropical cyclone— A tropical storm in which the maximum of the average wind speed is estimated to be in the range of 90 to 115 knots (165 to 212 km per hour).

Very intense tropical cyclone— A tropical storm in which the maximum of the average wind speed is estimated to exceed 115 knots (212 km per hour).

Average wind speed— Speed of the wind averaged over the previous 10 minutes.

Maximum wind speed in a tropical storm— Maximum value of the surface wind speed averaged over 1 minute.

Gust— Instantaneous peak value of surface wind speed.

Western North Pacific Ocean

Tropical disturbance— A discrete system of apparently organized convection, generally 100 to 300 nautical miles in diameter, originating in the tropics or subtropics, having a non–frontal, migratory character and having maintained its identity for 12 to 24 hours. It may or may not be associated with a detectable perturbation of the wind field (definition used by JTWC).

Cyclonic disturbance— A non–frontal synoptic scale low pressure area originating over tropical waters with organized convection and definite cyclonic wind circulation.

Tropical cyclone— A non–frontal, migratory low–pressure system, usually of synoptic scale, originating over the tropics or subtropical waters and having a definite organized circulation (definition used by JTWC).

Low Pressure area— An area bounded by a closed isobar with minimum pressure inside when the central pressure cannot be accurately assessed and the maximum sustained wind is less than 34 knots.

Tropical depression— A cyclonic disturbance in which the central position can be identified and the average maximum sustained wind speed is less than 33 knots (61 km).

Tropical storm— A cyclonic disturbance in which the maximum sustained wind speed is in the range of 34 to 47 knots (62 to 88 km per hour).

Severe tropical storm—A cyclonic disturbance in which the maximum sustained wind speed is in the range of 48 to 63 knots (89 to 117 km per hour). (Not used by JTWC—in their terminology tropical storm covers the range 34 to 63 knots).

Typhoon— A tropical cyclone with maximum sustained surface winds of 64 to 129 knots (118 to 239 km per hour). (WMO uses typhoon to cover all winds of 64 knots or more).

Super typhoon— A typhoon with maximum sustained surface winds of 130 knots (241 km per hour).

Maximum sustained wind speed— The highest surface wind speed averaged over a 1–minute period of time.

Subtropical cyclone— A low pressure system that forms over the ocean in the subtropics and has some of the characteristics of a tropical circulation, but not a central dense overcast. Although of upper cold low or low–level baroclinic origins, the system can transition to a tropical cyclone.

Bay of Bengal and Arabian Sea

Cyclonic disturbance— A non–frontal synoptic scale low pressure area originating over tropical waters with organized convection and definite wind circulation.

Depression— A cyclonic disturbance in which the maximum sustained surface wind speed is between 17 and 33 knots (31 and 61 km per hour). If maximum wind speed lies in the range 27 to 33 knots (50 to 61 km per hour) the system may be called a **deep depression**.

Low pressure area (Low)— An area enclosed by a closed isobar with minimum pressure inside when mean surface wind is less than 17 knots (31 km per hour).

Tropical depression— A cyclonic disturbance in which the maximum average wind speed is in the range of 17 to 33 knots (31 to 61 km per hour).

Cyclonic storm— A cyclonic disturbance in which the maximum average surface wind speed is in the range of 34 to 47 knots (62 to 88 km per hour).

Severe cyclonic storm— A cyclonic disturbance in which the maximum average surface wind speed is in the range of 48 to 63 knots (89 to 117 km per hour). When wind speeds reach 64 knots (118 km per hour) or more it is referred to as a **severe cyclonic storm with a core of hurricane winds**.

North Atlantic, Eastern North Pacific and Central North Pacific

Tropical wave— A trough or cyclonic curvature maximum in the trade wind easterlies. The wave may reach maximum amplitude in the lower middle troposphere, or may be the reflection of an upper–troposhpere cold low or equatorial extension of a mid latitude trough.

Tropical disturbance— A discrete system of apparently organized convection originating in the tropics or subtropics, having a non–frontal migratory character and having maintained its identity for at least 24 hours.

Tropical cyclone— A non–frontal cyclone of synoptic scale, developing over tropical or subtropical waters and having a definite organized surface circulation.

Tropical depression— A tropical cyclone in which the maximum average surface wind (1 minute mean) is 33 knots (62 km per hour) or less.

Tropical storm— A well organized warm–core tropical cyclone in which the maximum average surface wind (1 minute mean) is in the range 34 to 63 knots (63 to 117 km per hour) inclusive.

Hurricane— A warm–core tropical cyclone in which the maximum average surface wind (1 minute mean) is 64 knots (118 km per hour) or greater.

Subtropical cyclone— A low pressure system, developing over subtropical waters, which initially contains few tropical characteristics. With time the subtropical cyclone can become tropical.

Subtropical storm— A subtropical cyclone in which the maximum sustained surface wind is 34 knots (63 km per hour) or greater.

Subtropical depression— A subtropical cyclone in which the maximum sustained surface wind is less than 34 knots (63 km per hour).

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

National Hurricane Center
1320 South Dixie Highway
Coral Gables, FL 33146

March 23, 1990

Richard DeAngelis, Editor
Mariners Weather Log
National Oceanographic Data Center
Washington D.C. 20235

Dear Dick:

This is to remind your readers of the importance of ship reports as a data source for tracking tropical cyclones. Of course, weather satellites have been a marvelous surveillance tool for almost thirty years. We also rely on aircraft reconnaissance when the tropical cyclone is within reach. However, when determining surface wind speeds, both satellites and aircraft have their limitations. Geostationary satellites are very remote sensors and wind speeds determined from a satellite are, at best, estimates. There is also uncertainty in the estimation of surface wind speeds from aircraft flight level wind observations.

Hurricane Erin (see "North Atlantic Tropical Cyclones, 1989") provides a good example of the importance of ship reports. On August 22nd, we were tracking Erin by satellite in the central north Atlantic Ocean. The Portuguese ship **Montemuro** reported a west wind at 65 knots, while located just south of Erin's center. The reported pressure and pressure tendency substantiated the validity of that wind observation. The satellite-based wind speed estimate was only 45 knots then and did not reach hurricane force for another 18 hours. Because of this timely ship report, we upgraded Erin to a hurricane 18 hours earlier than otherwise would have been possible.

As a former naval officer, I appreciate the burden of taking and sending ship reports. As a hurricane forecaster let me assure you that ship reports are a critical source of real measurements on which we rely heavily, particularly in the formative storm or depression stages. If we have the observations and are doing our job correctly, there won't be any ships near a fully-developed hurricane. Perhaps this will serve as a reminder to mariners that quality weather observations are important and appreciated.

Sincerely yours,

Jerry D. Jarrell

Jerry Jarrell
Deputy Director
National Hurricane Center

What Causes Hurricanes and How Do They Differ from Typhoons?

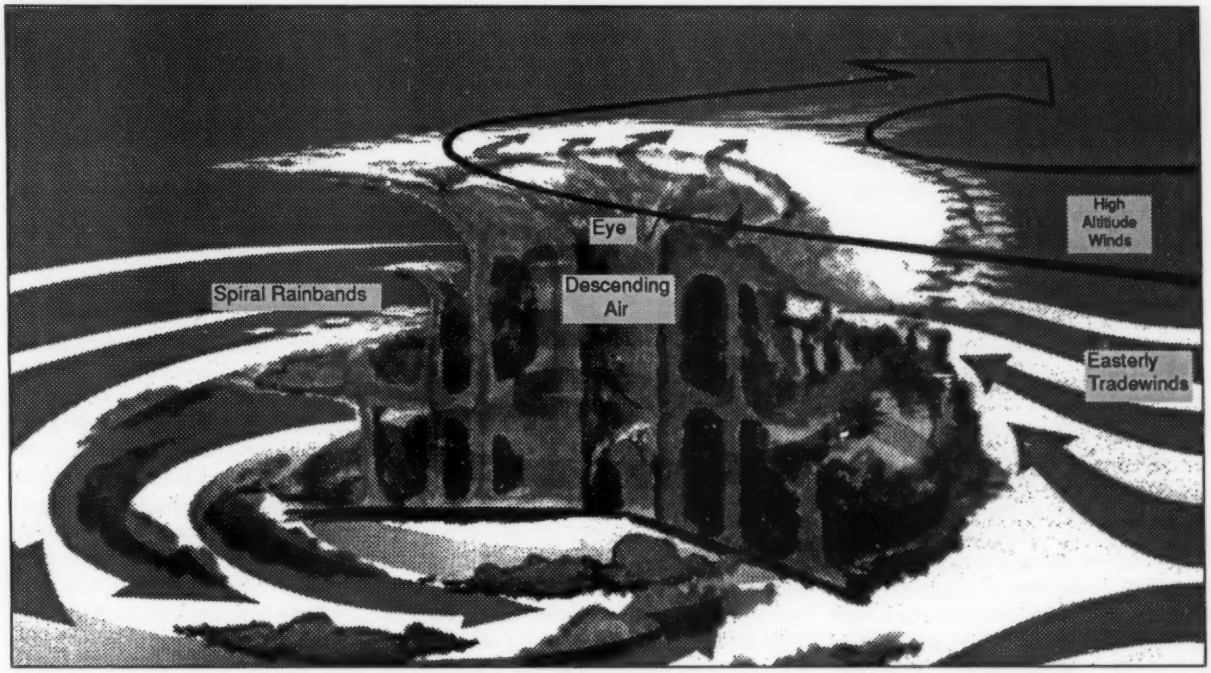
As long ago as the 1700s William Dampier observed: *"Though I have never been in any hurricane in the West Indies, yet I have seen the very image of them in the East Indies, and the effects have been the very same; and for my part I know no difference between a hurricane in the West Indies and a tuffon on the coast of China in the East Indies, but only the name. And I am apt to believe that both words have only one signification, which is violent storm."*

Dampier's observation has stood the test of time. Although typhoons are frequently larger and more intense than North Atlantic hurricanes, their origins, structure and features are alike. The difference in size and intensity is often attributed to the vast expanse of warm water in the western North Pacific. Generically these storms are known as tropical cyclones and form in the South Indian Ocean, South Pacific Ocean, Bay of Bengal and Arabian Sea, as well as the entire North Pacific, Caribbean Sea, Gulf of Mexico and North Atlantic.

Hurricane formation was once believed to result from an intensification of convective forces that produce the cumulonimbus towers of the doldrums, whose light winds have filled our literature with becalmed ships and thirsty sailors. However, this hypothesis failed to explain, among other things, the drastic drop in atmospheric pressure so essential to the development of hurricane–force winds. The exact triggering mechanism of tropical cyclone formation is still unknown but scientists today treat tropical cyclones as atmospheric heat engines much like the gasoline engine in a car. The starter mechanism, which intensifies the initial disturbance, is usually an intruding polar trough, easterly wave, or an eddy from the Intertropical Convergence Zone (ITC). The initial disturbance becomes a region into which low–level air from the surrounding area begins to flow, accelerating the convection already occurring inside the disturbance. The warm, moist air from near the ocean's surface acts as gasoline to fuel the heat engine. As it ascends and cools, due to decreasing pressure, it condenses releasing large amounts of heat energy to drive the wind system, which spirals counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. However, this incipient storm would soon fill up because of the air inflow at lower levels if there were no exhaust system in the form of upper level winds. These winds pump ascending air out of the cyclonic system into a high altitude anticyclone, which transports the air well away from the disturbance before sinking occurs. If everything works right, a large–scale vertical circulation is set up in which low–level air is spiraled upward and, after a trajectory over the sea, returned to lower altitudes some distance from the storm. This becomes a self–perpetuating process that intensifies the circulation, causing the engine to run faster and the tropical cyclone to increase in size. The pumping action and the heat released by the ascending air may account for the sudden drop of atmospheric pressure at the surface, which produces the steep pressure gradient along which winds reach hurricane proportions.

It is believed that the interaction of the low–level and high–level wind systems determines the intensity that the hurricane will attain. If less air is pumped out than converges at low levels, the system will not be sustained and die out. If more air is pumped out than flows in, the circulation will be sustained and will intensify. The view of tropical cyclones as atmospheric heat engines is necessarily general and simplified. The exact role of each contributor is not completely understood. The engine seems to be both inefficient and unreliable; a myriad of delicate conditions must be satisfied for the atmosphere to produce a hurricane. Their relative infrequency indicates that many a potentially healthy tropical cyclone ends early as a misfiring dud of a disturbance, somewhere over the sea.

Portrait of a Hurricane



This is a portrait of a tropical cyclone as seen by satellite, radar and illustrator. The cutaway view of the storm is greatly exaggerated in the vertical dimension. Actual tropical cyclones are less than 50 thousand feet high and may cover a diameter of several hundred miles. This is a view of a Northern Hemisphere tropical cyclone, since the circulation is in a counterclockwise direction. The cyclonic spiral is marked by heavy cloud bands from which torrential rain falls, separated by areas of light rain or no rain at all; these spiral bands ascend in decks of cumulus and cumulonimbus clouds to the convective limit of cloud formation, where condensing water vapor is swept off as ice–crystal wisps of cirrus clouds. At lower levels, where the tropical cyclone is most intense, winds on the rim of the storm follow a wide pattern, like the slower currents around the edge of a whirlpool, and like those currents, these winds accelerate as they approach the center of the vortex. The outer band has light winds at the rim of the storm, perhaps no more than 30 knots; within 30 miles of the center, winds may have velocities exceeding 150 knots. The inner band is the region of maximum wind velocity, where the storm's worst winds are felt, and where ascending air is chimneyed upward, releasing heat to drive the storm. In the tropical cyclone, winds flow toward the low pressure in the warm, comparatively calm core. There, converging air is whirled upward by convection, the mechanical thrusting of other converging air, and the pumping action of high–altitude circulations. This spiral is marked by thick cloud walls curling inward toward the storm center, releasing heavy precipitation and enormous quantities of heat energy. At the center, surrounded by a band in which the vertical circulation is the strongest, is the core— the eye of the tropical cyclone. The eye, like the spiral rainbands, is unique to the tropical cyclone; no other atmospheric phenomenon has this calm core. On the average, eye diameters are about 14 miles, although 25–mile diameters are not unusual. From the heated tower of maximum winds and cumulonimbus clouds, winds diminish rapidly to something less than 15 knots in the eye; at the opposite eyewall, winds increase again but from the opposite direction. It is spectacular. The eye's abrupt existence in the midst of opaque rain squalls and hurricane winds, the intermittent bursts of blue sky and sunlight through light clouds in the core of the cyclone, the galleried cumulus and cumulonimbus clouds must have seemed to primitive man like an excessive whim of arbitrary gods. While a tropical cyclone lives, the transaction of energy within its circulation is immense. If taken to be a heat engine, the efficiency with which the tropical cyclone converts thermal to mechanical energy is quite low, near 3 percent. Nevertheless, the condensation heat energy released by a hurricane in one day often is the equivalent of that released by the fusion of 400 20–megaton hydrogen bombs. Put in more comprehensible terms, one day's released energy, converted to electricity, would supply the United States electrical needs fore more than 6 months.

VOS and the Hurricane Season

Martin S. Baron
National Weather Service
Silver Spring, MD 20910

The enormous destructive power of tropical storms is a matter of great concern to ship captains. The most severe weather is normally encountered within about 75 miles of the storm center, but to retain the freedom to maneuver your vessel, it is preferable to stay outside a radius of 200 miles. Meteorologists of the National Weather Service (NWS) keep a very close watch on the Atlantic and Pacific oceans during the hurricane season, and closely examine all available data from these areas.

Your ship reports provide critically important information used to predict hurricane development, movement, and intensity. Even several hundred miles away from a storm, ship reports furnish important details about the surrounding air mass, and supporting low level circulation and air inflow.

In the Northern Hemisphere, the hurricane season runs from May to November, with August and September the peak time (the warmest time of year for the tropical oceans):

June, too soon; July, stand by; August, beware you must; September, remember; October, all over.

This is a useful, but not entirely correct ditty to help remember the months of the hurricane season.

In the Southern Hemisphere, peak season is about November to May, with January to March the most active months (see centerfold).

Tropical storms generally form on the western sides of the oceans, where the trade winds have blown for long distances over warm sea. Some, however, form on the eastern sides of the oceans. Formation is limited to a latitude band about 8–20 degrees on each side of the equator, away from the subtropical jet streams. They do not form nearer the equator, because the Coriolis force is not strong enough to start a cycling, swirling motion (the Coriolis force is a deflecting force due to the rotation of the earth, which acts on moving air; maximum at the poles, zero at the equator).

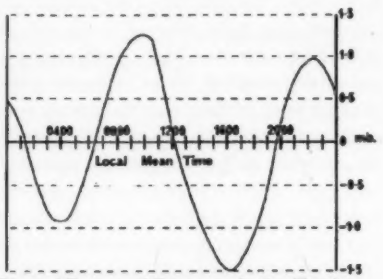
Special (SPREP) and Storm (STORM) reports from your vessel are particularly welcome during hurricane season. Send a SPREP at any time to alert the NWS to significant weather that has not been forecast. STORM reports should be sent at intervals of at least 3 hours if your vessel is within 300 miles of a named tropical storm or hurricane. Examples:

BBXX SPREP (Standard Weather Report) Lowest SL PRES 999 MB 1300Z

SUSTAINED WIND 38 GUST 63 KTS 1250Z

BBXX STORM (Standard Weather Report) TS DEAN FORCE 10 GUST 74 KTS 1455Z PRESS FALL RAPID

Your barometer is a dependable tropical storm indicator. Since air pressure changes are normally very small in low latitudes, you can observe the regular diurnal pressure variation pattern from your barograph (below). If you detect a marked departure from the normal diurnal variation in atmospheric pressure while in the tropics, say 5 mb below normal, a tropical storm is almost certainly within 200 miles of your vessel. Under these circumstances, please send a SPREP to alert the NWS to this condition.



Diurnal Range of Pressure in the Tropics

Melrose Visits the Pride

On April 6th Bob Melrose, PMO for Baltimore and Vince Zegowitz, Marine Observation Program Leader, visited the ***Pride of Baltimore II*** to deliver final supplies and calibrate equipment before the vessel sails for Europe where she will spend all of 1990 and most of 1991. She will then head for South America, visiting ports there through 1991 and 1992. In all more than 40 cities located on four continents will be visited by the Pride, which will not return home until the summer of 1992 for the gathering of the Tall Ships in honor of the 500th anniversary of the discovery of America.

New PMO In Honolulu

Mr. Jeff Brown has been selected as the new Port Meteorological Officer for Honolulu, HI, replacing Pete Celone who is now working for the National Ocean Survey in Washington, D.C. More information on Jeff will appear in the next issue.

PMO Takes Fam Cruise

Jim Nelson, PMO Houston, recently rode the ***Nedlloyd Hudson*** from Houston to Jacksonville, on a PMO familiarization cruise. He worked with mates on observing skills, particularly concerning cloud identification and the reporting of sea and swell. In turn, he learned from the mates and engineers about their daily (non Meteorological) duties, and shipboard routine. The ***Nedlloyd Hudson*** is one of 12 vessels used by **Sea–Land** in their U.S. to Europe trade. Jim wishes to express his gratitude to **Sea–Land** service and the officers on the vessel for their hospitality and cooperation.

New Computers for PMOs

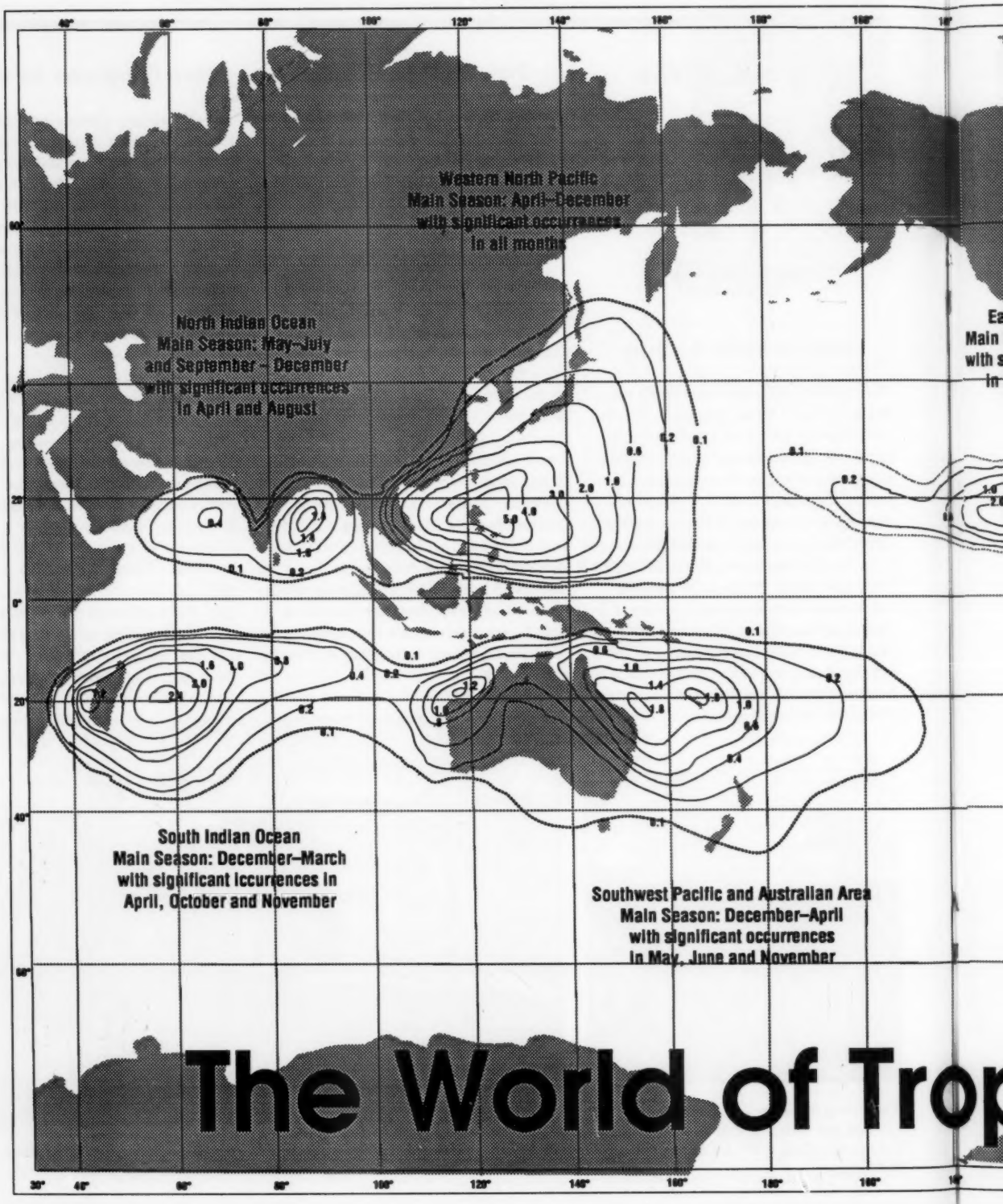
The Voluntary Observing Ship (VOS) Program has a computer database, used to help monitor and keep track of program activities. The database contains an inventory of all VOS program ships with their mailing addresses and available observing equipment. A record of all PMO ship visitations is maintained, as well as a monthly ship report data file. As part of a NOAA–wide conversion process, the VOS database is being converted from a DEC system 20 computer to an IBM 370/3090, model 400. PMO's will dial into the IBM system using modems connected to their personal computers. The new system will be more powerful and versatile than the old one and is expected to be fully operational during the summer of 1990.

New Recruits

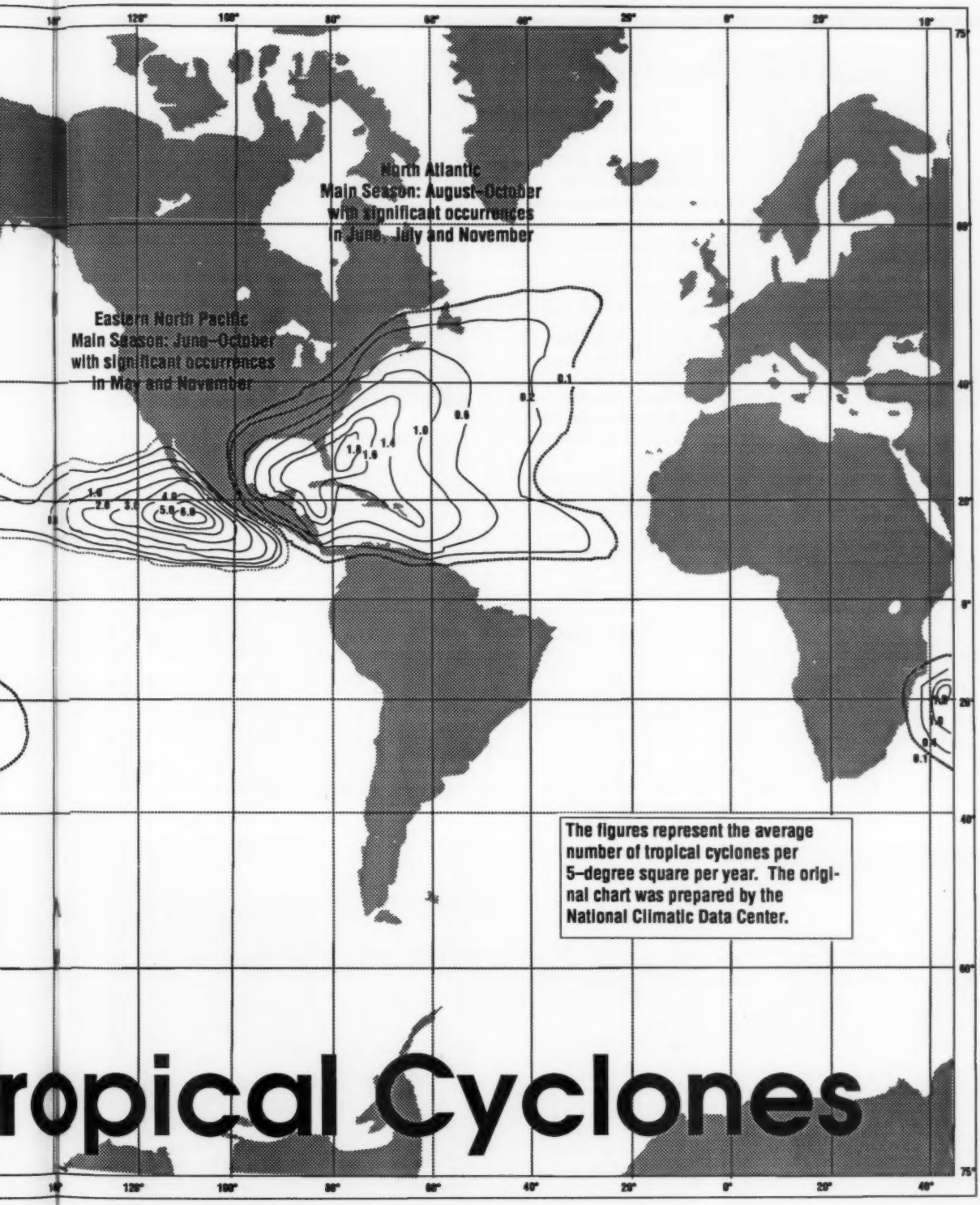
The Port Meteorological Officers recruited a total of 43 vessels during the first quarter of 1990. We thank these ships for joining the program.

The Pride of Baltimore II sits behind its Captain, Jan Miles (left) and the former Panamanian devil, PMO Bob Melrose now of Baltimore.

NOAA's most photographed PMO, Jim Nelson of Houston, is seen here aboard the Nedlloyd Hudson on his familiarization cruise. Some guys will do anything to get photographed.



The World of Trop


North Atlantic
Main Season: August–October
with significant occurrences
in June, July and November
Eastern North Pacific
Main Season: June–October
with significant occurrences
in May and November
The figures represent the average number of tropical cyclones per 5–degree square per year. The original chart was prepared by the National Climatic Data Center.

ropical Cyclones

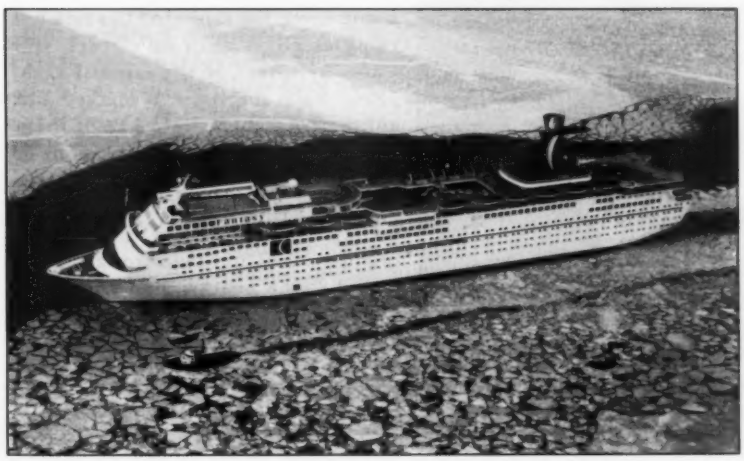
New Recruits January–March 1990

Aino	LAGG2	C.H. Soerensen & Soenner
America Maru	JCDT	Williams Dimond & Co.
Antipolis	SWUQ	N.J. Goulandris the Adelphi
Bow Serene	LAGD2	Skibsaksjeselskapet Storli
Brilliancy	ELBS3	Teekay Shipping Co.
Columbus Olivos	ELMW9	Columbus Line, Inc.
Comorant Arrow	C6I09	Gearbulk Container Services
Del Monte Packer	ELIT9	Del Monte Fresh Fruit Intl.
Ever Garland	V7CA	Evergreen Marine Corp.
Golden Monarch	KLGF	Apex Marine Corp.
Golden Trader	3EKQ7	Rainier Shipping Co.
Hesiod	VSBN4	Kerr Steamship Co., Inc.
Hyundai No. 201	3EWQ5	Hyundai Merchant Marine Inc.
Hyundai No. 102	D9RB	SEMCO
Indian Ocean	ELIG7	Ecuadorian Lines
Japan Alliance	7KBW	Merit Steamship Co.
La Marquesa	3EPB2	Rainier Shipping Co
Laura Maersk	OYBF	Maersk Line
Lilas	DVBF	Cascade Shipping Co.
Maren Maersk	OWUZ2	Maersk Lines
Melanie	DUPF	Compass Marine (USA)
Mekur Delta	ELDV6	AAEL
Namsam Spirit	ELHS9	Teekay Shipping Co. Inc.
Nedlloyd Manila	PGDI	Nedlloyd Lines
OMI Missouri	WBKX	Vulcan Carriers Ltd.
Osprey Arrow	ZEKL	Jardine Ship Management Ltd.
Overseas Valdez	WOVS	Overseas Valdez T–AOT 1204
Pacsea	ELJJ7	Lasco Shipping Co.
Pacsun	ELJI2	Lasco Shipping Co.
Pine Forest	YJXL4	Williams Dimond & Co.
Pocantico	9VAN	Chilean Line Inc.
Prospero	3EXS7	Sembawang Johnson Ltd.
Rimba Keruing	9MWU	Barber Wilhelmsen Agency
Samuel L. Cobb	KCDJ	
Santa Victoria	WXGO	Santa Victoria
Spring Seagull	ELKB2	Williams Dimond & Co.
Stellar Beny	DZSB	SMI Group
Tumilco	XCIT	Care Shipping Inc.
USCGC Confidence	NHKW	Commanding Officer
USCGC Orcas	NTBZ	Commanding Officer
USNS Navisota	NHOP	Capt. of Navisota
Windward Sentry	NLYJ	USCG Map Miami

Captain Ed Savage (above, left) is retiring from Sea–Land Service, Inc. in Houston. Ed's continuing interest in the VOS program was second to none and he will be missed. We wish him a happy retirement. Presenting Ed with a certificate and letter of appreciation is, who else, Jim Nelson, PMO of Houston. Ed's relief, Bill Prindiville (below, right) is also an old hand in fleet operations, so a smooth turnover is expected. Bill comes to Houston by way of Tacoma, Washington.

A Pete Connors' Production

One of the main functions of the Port Meteorological Officers is to recruit new vessels into the Voluntary Observing Ship program and, as can be seen on the previous page, they do a good job. Above left the Gulf Sentry is one of our new vessels. Receiving a plaque for her participation is, from left to right, Captain Van Moore, PO/2c Stan Lecain and CPO Steve Tucker. PMO Pete Connors is the guy with the tie. LeCain and Tucker are in the U.S. Coast Guard. Pete also presented a plaque to the Pacific Sentry (top right and middle right). Accepting the plaque is Captain Scott Thompson (left) and MST 1 Marty Smith. The M/V Cariban is another Pete Connors' vessel (middle left) and receiving the award is Captain William A. Macritchie and to the right of Pete is R/O N Pervaiz. The photo was taken by Ch/Off. R. Knowles. Below (left and right) the Fantasy joins the VOS program. The Fantasy is Carnival Cruise Lines newest ship and receiving the plaque on her behalf is Captain Raffaele Gavino. This beautiful vessel is more than 850 feet long and carries some 2600 passengers. It is seen here departing Helsinki, Finland where it was built. Photo by Gero Mylius, copyright Wartsila, AV–Dept. Finland. Photo courtesy of Captain Vittorio Fabietti.



About this Issue

This tropical cyclone special issue is something that I have had in mind for quite awhile. I hope it will provide a sort of reference for this important topic. We were hoping to include a summary of the the South Pacific region as well, but it was just not available by press time. We will try to publish it in the future. Many people were involved in the effort to make this issue a success. The staff at the National Hurricane Center (below) went out of their way to make the summaries available as early as possible as did the folks in the Central Pacific Hurricane Center. Frank Wells at the Joint Typhoon Warning Center and Ted Tsui at the NOARL West were more than cooperative with the summary for the Western North Pacific basin. Howard April was instrumental in obtaining the tropical cyclone definitions and Elinor DeWire went out of her way to write a wonderful article on storms and lighthouses.

We also received assistance with the tropical cyclone names from D.J. Linforth, Superintendent of Public and Marine Weather Services, Bureau of Meteorology of Australia, Rajendra Prasad of the Fiji Meteorological Service and J.L. Ravard, Chief of the Meteorological Service of Reunion. Also, I don't want to forget Mike Longworth of Vanuatu who really got this whole thing rolling with his letter. It would be nice, in the future if this could become a regular feature, but that depends upon the reaction to this issue, since it does require a lot of effort.

I would like to make one other thank you. If you notice the improvement in the mean pressure charts in the Marine Weather Review, this is due to the help we receive from the Climate Analysis Center of NOAA, particularly Vernon Kousky and John Kopman.

Some of the National Hurricane Center staff participate in a forecast coordination discussion. From left to right are Lixion Avila, Joel Cline, Robert Case, Miles Lawrence (who is really better looking than this photo indicates), Sgt. Greg Skoloff and NHC Director, Dr. Robert Sheets (on the phone).

Available Again

Years ago the Weather Bureau had a wreck and casualty chart of the Great Lakes. It was old and in poor shape and eventually gave out. Now the Historical Society of Michigan, who furnishes our lighthouse pieces on the inside cover, has reprinted this rare but popular chart entitled: Wreck and Casualty Chart of the Great Lakes, 1894. Each shipwreck is marked and annotated. There were 112 of them that year. Also noted are locations of lighthouses and life saving stations. The chart is reprinted to exact detail on top quality parchment paper in original colors and measures 23x 32½ inches. Its a beauty. For prices and more information write the Historical Society of Michigan, 2117 Washtenaw Av., Ann Arbor, MI 48104 or call (313) 769–1828.

Getting to Know Your PMO

James Nelson PMO, Houston

James Nelson is the Port Meteorological Officer at Houston, Texas although he operates out of Alvin, Texas. We kid Jim about the number of photographs he has been in over the past year or two but in reality it reflects the hard work that he does and his friendly nature, beside being a natural ham. We want to thank him for taking the time out of his busy schedule for the interview.

MWL: Did you begin with NWS as a PMO?

Jim: I joined at the Weather Service Office in Galveston, Texas. After 3 years there, I applied for the PMO position here in Houston and have been on the job since May 1987.

MWL: What did you do before joining NWS?

Jim: I worked for 9 years at the National Climatic Data Center. While there, I checked surface observations for 4 ½ years and upper air observations for 6 months before moving on to become assistant to the Chief of the Technical Data Section. Before 1975, I served in the U.S. Navy for over 20 years.

MWL: Does your job involve a lot of travel?

Jim: Covering the Houston Ship Channel requires a great deal of traveling. I will cover between 85 and 125 miles each day. It takes me about 1 hour to reach the closest pier from my office. I have to plan my trips carefully so that I don't end up somewhere where there are no ships. But even with the best planning, it sometimes happens.

MWL: Was Houston hit by tropical storms this year?

Jim: Yes!!! We had more than our share of tropical weather this past year. Three storms came ashore in the immediate vicinity and caused problems. The ship channel was closed three times due to damage, once for a week.

MWL: Do your ships realize the importance of observations, especially during the hurricane season?

Jim: They know that without the data which they provide, we cannot provide the accuracy we would like to have in the forecasts. I always stress the value of even sending in observations in coastal waters.

MWL: How did you get into the business of updating the Marine Weather Broadcast schedules as an added duty?

Jim: When I started visiting ships back in 1987, I was quite often asked for more up–to–date facsimile schedules. The books we had available were not being kept current so, a little bit at a time, I started getting these schedules together. I am able to keep current with most broadcast schedules and make them available to shipping through the PMOs.

MWL: How about your family?

Jim: My wife Betty and I have been married for nearly 30 years. We have four children and three grandchildren. My wife is an EMT–I and volunteers much of her time to the local Emergency Medical Service. She also works part time at the local hospital. Our children are scattered from Jacksonville, Florida to Seattle, Washington.

MWL: Apart from posing for NOAA photos, do you have any hobbies?

Jim: My computer is my hobby. I have an IBM/XT clone presently, but I plan to upgrade to a 386 sometime this year.

MWL: Many people ask about Julius Soileau (former PMO). How is he?

Jim: Julius was doing well the last time I saw him. He said he might be going to school and he still travels a lot.

One Final Word

Dear Dick:

Your publicizing letters from Radio Officers describing their concerns over the implementation of the GMDSS is commendable. By echoing their reservations, the Mariner's Weather Log helps alert Radio Officers and others to anticipated problems with GMDSS operations and equipment, pointing the way to early correction.

As a sea-going Radio-Electronics Officer I have helped save lives during distresses with radio-telegraphy. As Technical Director of the Radio-Electronics Union I have participated in the GMDSS planning and design at the International Maritime Organization in London and at the International Telecommunications Union in Geneva. This latter privilege has afforded me a unique perspective. During assembly meetings involving hundreds of delegates, often fewer than twenty had ever been to sea. They were mostly administrators with links to ship owners and others with vested economic interests in the GMDSS. They relish high-tech electronic schemes. The GMDSS is designed to meet only their standards.

The GMDSS is scheduled for implementation between 1992 and 1999. During that time both the GMDSS and our present radio safety system are supposed to operate in parallel. Many countries will race to implement it at the earliest time. They erroneously believe they can realize huge savings in the removal of Radio Officers from their ships. Reduced manning played a large part in the GMDSS hidden agenda for many nations, including the U.S.

The exclusive dependence of many ships upon the GMDSS in its early stages is not a prudent policy. There will be serious on-going complications with both ship and shore-based hardware and software, operational errors, lack of reliability, and inevitable losses of life and property. The basic incompatibility of the two systems will elevate routine problems to major maritime tragedies.

But there is no going back. Radio-telegraph will be phased out in the commercial maritime service. Whatever the maritime shipping community may prefer, they and their underwriters are stuck with the GMDSS.

So what happens to "Sparks"? To the extent he is a "brass pounder," his services will not be needed. To the extent he is a skilled maritime electronics technician and expert communicator, his services will become essential and vital for any productivity gains.

Electronics technology has always been part of the tool kit of the Radio Officer. The night before the Titanic sank in icy north Atlantic waters, the Chief Radio Operator John G. Phillips and his Second Operator Harold Bride repaired the ship's transmitter. Have more lives been saved with knowledge, a voltohmeter and soldering iron than a telegraph key? It's hard to say, but the idea is one whose time arrived in 1912.

Ships daily become more dependent upon their electronic control, communication, and navigation systems. The GMDSS will place even greater reliance upon automatic electronic devices. Meanwhile, conditions of heat, moisture, vibration and random failure will take their usual toll at sea. Who will repair them? The burden of preventive and corrective maintenance will necessarily fall upon the shoulders of skilled Radio-Electronics Officers. Attempts to avoid or defeat REO recognition through fraudulent licensing schemes are falling apart.

Radio-telegraphy has served its purpose. It added immeasurably to safety of ships, their crews and passengers. Whatever our emotional attachments to radio-telegraphy, it is not the wave of the future. This is the time of the skilled, licensed, sea-going electronics technician. Only he or she can help overcome the limitations of the GMDSS and correct its faults. By doing so, he or she will continue to save thousands of lives and billions of dollars in property.

Don Dishinger
Technical Director,
Radio–Electronics Union

HONOLULU, HAWAII, U.S.A.

CALL SIGN	FREQUENCIES	TIMES	EMISSION	POWER
KVM70	9982.5 kHz	2335-0112	F3C	10 KW
	11090 kHz	0540-0658	F3C	10 KW
	16135 kHz	1105-1242	F3C	10 KW
	23331.5 kHz	1755-1929	F3C	10 KW

TRANS TIME CONTENTS OF TRANSMISSION RPM/IOC VALID MAP

TIME AREA

0001/1201 FULL DISK INFRA-RED SATELLITE IMAGERY 120/576 00/12 GOES 0017/1217 PACIFIC SURFACE ANAL 120/576
18/06 B 0041/1241 TROPICAL SURFACE ANAL 120/576 18/06 C 0107/1307 48HR SURFACE/THICKNESS PROGS
120/576 12/00 D 0127/—— 24HR WIND/STREAM PROG 120/576 12/— E 0152/—— 48HR WIND/STREAM PROG
120/576 12/— E ——/1357 48HR OCEAN WINDS/SIG WAVE HT PROGS 120/576 —/00 F
0533/1733 TEST CHART/ID/SCHEDULE 120/576 0547/1747 SIGNIFICANT CLOUD FEATURES 120/576 00/12 A
0601/1801 FULL DISK INFRA-RED SATELLITE IMAGERY 120/576 06/18 GOES 0617/1817 PACIFIC SURFACE ANAL 120/576
00/12 B 0641/1841 TROPICAL SURFACE ANAL 120/576 00/12 C 0707/1907 72HR SURFACE/THICKNESS PROGS
120/576 12/00 D ——/1927 72HR OCEAN WINDS/SIG WAVE HT PROGS 120/576 —/12 F ——/1942 OCEAN SURFACE TEMPS
120/576 G
1133/2333 TEST CHART/ID/SCHEDULE 120/576 1147/2347 SIGNIFICANT CLOUD FEATURES 120/576 06/18 A

CHART AREAS: A - 40N 160E, 40N 110W, 25S 160E, 25S 110W
B - 55N 130E, 55N 110W, 25S 130E, 25S 110W
C - 30N 120E, 30N 110W, 50S 120E, 50S 110W
D - 60N 110E, 60N 055W, 55S 110E, 55S 055W
E - 50N 120E, 50N 105W, 30S 120E, 30S 105W
F - 60N 130E, 60N 115W, 35S 130E, 35S 115W G - 60N 100E, 60N 060W, 40S 100E, 40S 060W
ALL CHARTS ARE MERCATOR PROJECTION EXCEPT DISK VIEW FROM THE GEOSTATIONARY SATELLITE FROM ABOVE THE EQUATOR.

NOTES:
(1) TROPICAL SURFACE ANAL & WIND/STREAM PROG CHARTS DISPLAY 1000MB STREAM FUNCTION LINES. WIND SPEEDS IN KNOTS FOR ALL LATITUDES MAY BE APPROXIMATED BY DIVIDING 50 BY THE SPACING BETWEEN THE STREAM FUNCTION LINES EXPRESSED IN DEGREES OF LATITUDE. THESE CHARTS, COMPUTER GENERATED AT THE NATIONAL METEOROLOGICAL CENTER (NMC), WASHINGTON, DC, ARE PARTICULARLY USEFUL IN THE TROPICS, WHERE ISOBARIC SPACING AND WIND SPEED RELATIONSHIP BECOMES LESS MEANINGFUL. CENTERS ARE LABELED "A" FOR ANTICYCLONIC CIRCULATION AND "C" FOR CYCLONIC CIRCULATION AND MAY BE EQUATED TO HIGH AND LOW PRESSURE CENTERS, RESPECTIVELY. CAUTION IS ADVISED WHEN USING THESE CHARTS. BEING STRICTLY COMPUTER GENERATED, THEY MAY NOT PROPERLY DELINEATE SMALL, THOUGH INTENSE, SYSTEMS IN DATA-SPARSE AREAS. TO COMPENSATE, NOTES ARE MANUALLY ADDED TO DIRECT ATTENTION TO SUCH SYSTEMS, WHEN PRESENT.
(2) ARROWS ON THE TROPICAL SURFACE ANAL DEPICT VELOCITIES IN KNOTS OF LOWER CLOUDS.(3) PACIFIC SURFACE ANAL MANUALLY ANALYZED AT THE WEATHER SERVICE FORECAST OFFICE IN HONOLULU DEPICTS THE PRESSURE FIELD NORTH OF 15 NORTH AND STREAM LINES (NOT STREAM FUNCTION LINES) SOUTH OF 15 NORTH. STREAM LINES DELINEATE GENERAL DIRECTION OF WIND FLOW.
(4) THE SIGNIFICANT CLOUD FEATURES CHARTS ARE MANUALLY PRODUCED AT WSFO HONOLULU. THEY DEPICT BROAD FEATURES OF CLOUDS BASED UPON IMAGES FROM THE VARIOUS GEOSTATIONARY AND POLAR ORBITING SATELLITES. ABBREVIATIONS USED ON THESE CHARTS INCLUDE: AC - ALTOCUMULUS; AS - ALOTSTRATUS; BKN - BROKEN; CB - CUMULONIMBUS; CC - CIRROCUMULUS; CI - CIRRUS; CS - CIRROSTRATUS; CU - CUMULUS; FEW - FEW; ISOL - ISOLATED; LYRS - LAYERS; NS - NIMBOSTRATUS; OVC - OVERCAST; SC - STRATOCUMULUS; SCT - SCATTERED; TCU - TOWERING CUMULUS; TSTM - THUNDERSTORM.
(5) THE SATELLITE IMAGES ARE INFRARED CLOUD PICTURES TRANSMITTED IN REAL TIME AS THEY ARE BEING SCANNED BY GEOSTATIONARY SATELLITE.
(6) OTHER HIGH SEAS MARINE WEATHER BROADCASTS FROM HAWAII:
USCG RADIO NMO HONOLULU - SSB VOICE AY 0545, 1145, 1745 AND 2345 ON 2670 kHz, 6506.4 kHz, 8765.4 kHz, 13113.2 kHz
WWVH KAUAI, HAWAII - AM VOICE ON THE 48TH, 49TH, 50TH, 51ST MINUTE OF EACH HOUR ON FREQUENCIES 2.5, 5.0, 10.0, 15.0 mHz.
(7) YOU MAY ADDRESS COMMENTS ABOUT THIS BROADCAST TO:

REGIONAL DIRECTOR
NATIONAL WEATHER SERVICE, NOAA
P.O. BOX 50027
HONOLULU, HAWAII 96850
PHONE: 808-836-1831

(INFORMATION DATED 01/1990)

Ship Weather Reports

All ship's weather reports transmitted to shore should include **BBXX** as the first group in the text followed by the **ship call sign**.
Example:
BBXX VCTB 29003 99131 70808 41988 60909 10250 20211/40110 52003 71611 85264 22234 00261 31100 40803

BATHYTHERMAL/TESAC Observations

Ships are reminded to use the correct format for Bathythermal/Tesac Observations. Bathy/Tesac should start with **JJXX** and end with the **Call Sign**.

EXAMPLE: **JJXX** 20106 0312/ 74519 05528 88888 00098 26097 28098 29094 33069 36044 37026 38014 39009 41004 46503 48505 59508 84512 9901 36512 37512 38512 39355 46355 0000 **VCTB**

INMARSAT Format Example

BBXX VCTB 29003 99131 70808 41998 60909 10250 2021/ 40110 52003 71611 85264 22234 00261 31100 40803 ....

INMARSAT Reports Procedure

INMARSAT Equipped ships may transmit weather messages using the following procedures after the message is composed off-line:

1. Select U.S. Coast Earth Station Identification CODE 01.
2. Select routine priority.
3. Select duplex telex channel.
4. Initiate the call.
   Upon receipt of GA (Go Ahead).
5. Select dial code for meteorological reports, 41, followed by the end of selection signal, +.
   41+ (or 00 23 6715250+)
6. Upon receipt of our answerback, NWS OBS

MHTS, transmit BBXX, the ship's call sign and the weather message only. Do not send any other preamble.

Selected Worlwide Marine Weather Broadcasts

The 1989 edition of Selected Worldwide Marine Weather Broadcasts is availble from:

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ATTN: James Jansco

Tropical Cyclone Names for the 1990 Season

North Atlantic Ocean	Ern. North Pacific	South Pacific—Fiji
1990	1990	1989/90
Arthur	Alma	Nancy*
Bertha	Boris	Ofa*
Cesar	Cristina	Peni*
Diana	Douglas	Rae*
Edouard	Elida	Sina
Fran	Fausto	Tia
Gustav	Genevieve	Val
Hortense	Hernan	Wasa
Isidore	Iselle	Arthur
Josephine	Julio	Betsy
Klaus	Kenna	Cliff
Lili	Lowell	Daman
Marco	Marie	Esau
Nana	Norbert	Fran
Omar	Odile	Gene
Paloma	Polo	Hettie
Rene	Rachel	Innis
Sally	Simon	Joni
Teddy	Trudy	Kina
Vicky	Vance	Lin
Wilfred	Winnie	Mick

South Indian Ocean	
1989/90	1990/91
Alibera*	Alison
Baomavo*	Bella
Cezera*	Cynthia
Dety*	Debra
Edisaona*	Elma
Felana*	Fatima
Gregoara*	Gritelle
Hanta	Hazelle
Ikonjo	Inese
Jezebela	Julia
Klaovisy	Ketsia
Lapraozy	Lorna
Mosa	Mary
Ngita	Nadege
Osikara	Olivette
Pilaza	Prescilla
Raely	Quincy
Siza	Rosalie
Tsihaminy	Susan
Vero	Therese
Webera	Ursula
Yvety	Valerie
Zavamania	Wilna

Wrn. North Pacific
1990
Koryn
Lewis
Marian
Nathan
Ofelia
Percy
Robyn
Steve
Tasha
Vernon
Winona
Yancy
Zola
Abe
Becky
Cecil
Dot
Ed
Flo
Gene
Hattie
Ira
Jeana
Kyle
Lola
Mike
Nell
Owen
Page
Russ
Sharon
Tim
Vanessa
Walt
Yunya
Zeke
Amy
Brendan

Australia Regions

Eastern—Brisbane	Western—Perth	Northern—Darwin
1989/90	1989/90	1989/90
Felicity*	Pedro*	Laurence
Greg*	Rosita*	Marian
Hilda*	Sam*	Neville
Ivor*	Tina*	Olivia
Joy	Vincent*	Phil
Kelvin	Walter*	Rachel
Lisa	Alex*	Sid
Mark	Bessi	Thelma
Nina	Chris	Vance
Oliver	Daphne	Winsome
Polly	Errol	Alistair
Roger	Fifi	Bonnie
Sadie	Graham	
Theodore	Harriet	
Violet	Ian	
Warren	Jane	
Agnes	Ken	
Barry	Lena	
Celeste	Monty	
Dennis	Naomi	
Ethel	Oscar	

Papua New Guinea
1989/90
Agi
Epi
Guba
Ila
Ivu
Kama
Tako

Cen. North Pacific	
1990	(pronounced)
Aka	(AH–kak)
Ekeka	(eh–KEH-kak)
Hali	(HAH–lee)
Iniki	(ee–NEE–kee)
Keoni	(keh–OH–nee)
Li	(LEE)
Mele	(MEH–leh)
Nona	(NOH–nah)

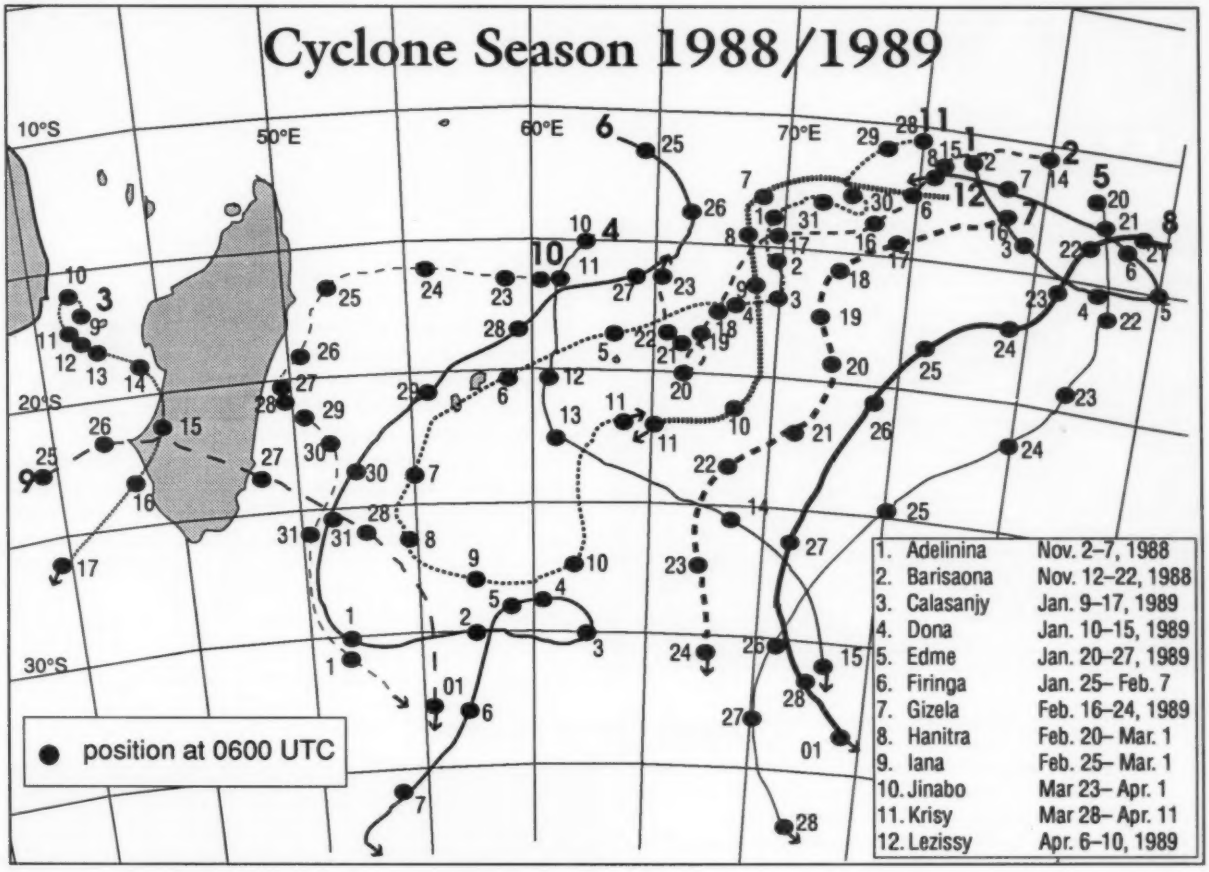
Notes— The Southern Hemisphere season runs, on the average, from November through Apri. Names in the South Indian Ocean list last from August to July. The following areas run their names in succession following on from the previous season: Wrn.and Cen. North Pacific,South Pacific and Australia. The Bay of Bengal and Arabian Sea region does not use names. In general if a name becomes infamous it is retired and another is used in its place. *indicates that this storm has occurred already this season.

Southwest Indian Ocean Cyclone Season, 1988/1989

Staff, Reunion Meteorological Service
(Translated by Rene´ Cuzon du Rest)

This season a total of seven tropical depressions and five tropical cyclones (winds 64 to 90 knots) developed in the southwest Indian Ocean. The first depression of the season was Adelinina, which formed about 325 nautical miles southeast of Diego Garcia early in November. Its minimum pressure dropped to 984 mb, while maximum 10–minute winds reached 44 knots. Tropical Cyclone Barisoana formed far east of Diego Garcia in November and was called 01S in the Australian area. Once it crossed 90°E, on the 11th, it became Barisoana. The maximum average wind speed was 72 knots with a minimum pressure of 954 mb. Tropical Cyclone Calasanjy came to life in the Mozambique Channel and reached cyclonic stage just before moving inland over Madagascar on the 14th of January 1989. The estimated maximum winds climbed to 72 knots with a 954–mb central pressure. The second of the four January storms was Dona, which developed northeast of St. Brandon on the 10th. Average maximum winds did not reach gale force in this storm. Edme was another tropical depression but its winds reached 62 knots around a 966–mb pressure center. The last of the January storms was Tropical Cyclone Firinga, which originated northeast of St. Brandon and headed southeastward. Firinga affected the weather of both Mauritius and the Reunion Islands. At St. Pierre/Terre Sainte, Reunion, gusts reached 116 knots on the 29th at 0827 UTC. The lowest pressure in the Reunion Islands was 962 mb at les Pointe des Galets. On Mauritius maximum average winds ranged from about 75 to 100 knots on the 28th and 29th. In general the average maximum winds in Firinga were estimated at 65 to 75 knots at sea and 75 to 85 knots over land, with gusts as high as 130 knots.

Three storms developed in February of 1989. Gizela and Iana were tropical depressions while Hanitra reached tropical cyclone strength. Originally Hanitra developed in the Australian sector under the name of Leon. However, it did not attain maximum intensity until it moved into the southwest region. Maximum winds (10 minutes) were estimated at 82 knots with gusts to 123 knots while minimum pressure dipped to 940 mb. Iana, although never getting beyond the moderate tropical depression stage, did cross Madagascar on the 26th. Morondava registered 43–knot gusts. The storm's maximum winds were estimated at 38 knots with gusts to 55 knots. Of the two March cyclones, Jinabo and Krisy, only Krisy reached tropical cyclone intensity. It formed southeast of Diego Garcia toward the end of March and strengthened to a tropical cyclone by the 2d of April, about 550 miles east of St. Brandon. Maximum wind gusts on Rodrigues were 66 knots at Pointe Canon (Port Mathurin). Krisy passed close to Mauritius on the 6th of April and at Plaisance Airport the pressure dropped to 976 mb, while gusts of 83 knots were measured. At Port Louis wind gusts were 61 knots and the minimum pressure was 982 mb. Over the 5th and 6th Arnaud measured more than 7 inches of rain. The storm's estimated maximum intensity included a 942–mb pressure with 10–minute maximum winds of 82 knots and gusts to 123 knots. The last storm of the season formed in April and was christened Lizissy southeast of Diego Garcia. It was never more than a moderate tropical depression. Average maximum winds were estimated at 44 knots around a 985–mb pressure.



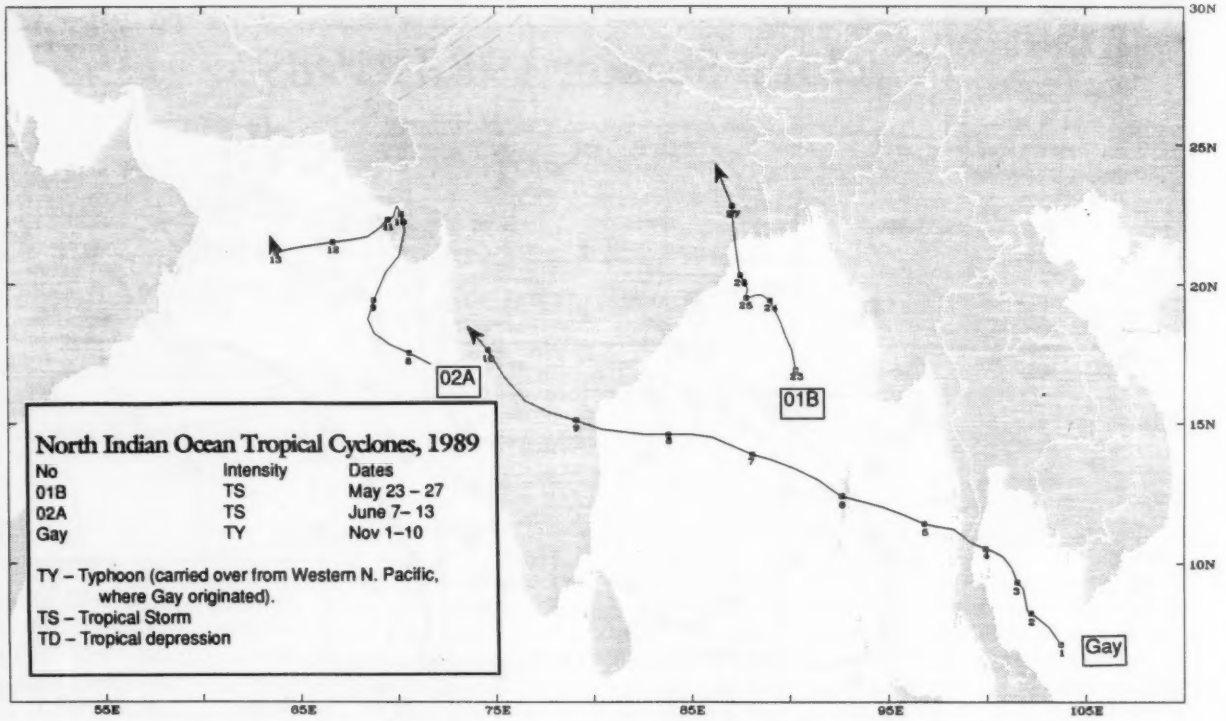
North Indian Ocean

During the 1989 season only three tropical cyclones came to life in the Bay of Bengal and Arabian Sea region, commonly known as the North Indian Ocean. In an average year this region can expect an average of 5.3 tropical cyclones; about 3.4 of these reach hurricane intensity. Most of the activity occurs in spring and fall. The peak months are October, November and May in that order.

Since 1966 annual totals have ranged from a high of 8 in 1966, 1968 and 1987 to a low of 2 in 1980. In the period of May through December, July and August are the most inactive months. During 1989 the track of Typhoon Gay across the Bay of Bengal was unusual in that the intensity of the typhoon was reminiscent of storms in the western North Pacific region, where Gay originated. Gay was the worst tropical cyclone to affect the Malay Peninsula in 35 years. Gay began in the Gulf of Thailand, sank a number of vessels, crossed the Malay Peninsula into the Bay of Bengal and slammed into India with peak sustained winds of 140 knots. Unique because of its small size, great intensity and point of origin, Gay was a challenge to forecasters.

Tropical Cyclone 01B developed on May 23 in the Bay of Bengal and headed toward the north northwest. After jogging slightly westward on the 24th, it resumed its former track and moved ashore on the 26th, near Calcutta. Maximum winds were estimated at 55 knots at 1200 on the 26th.

Tropical Cyclone 02A came to life late on the 7th of June in the Arabian Sea, southwest of Bombay. For the next several days it remained as a tropical depression as it moved northwestward and then toward the north northeast. Late on the 9th, it moved ashore over Kathiawar as a weak depression. However on the 11th it moved back into the Arabian Sea and attained a minimal tropical storm intensity of 35 knots on the 12th.

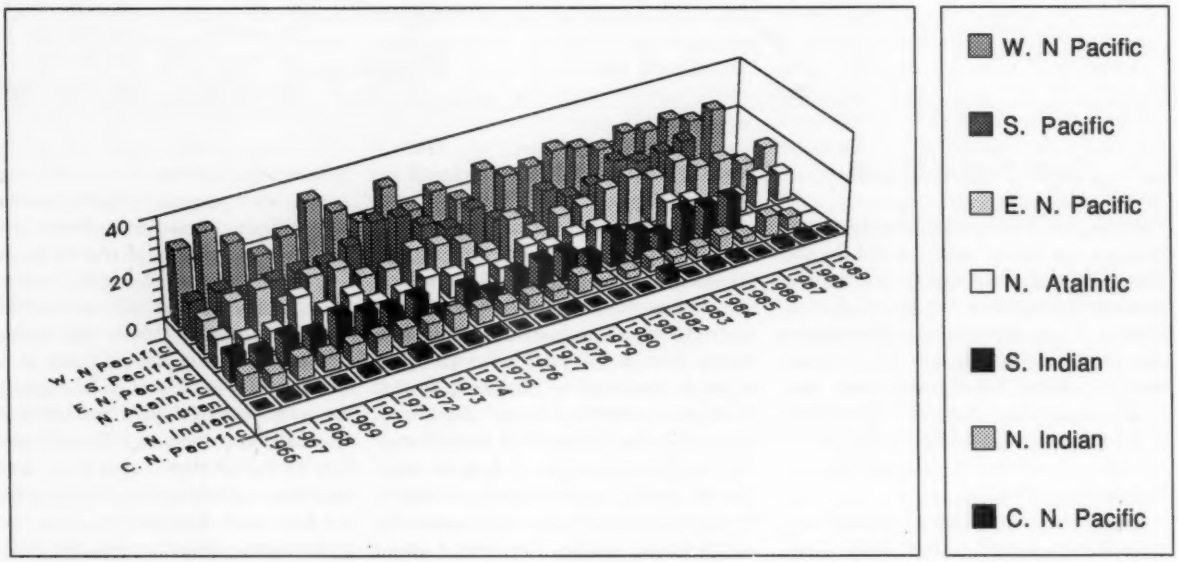


North Indian Ocean Tropical Cyclones, 1989

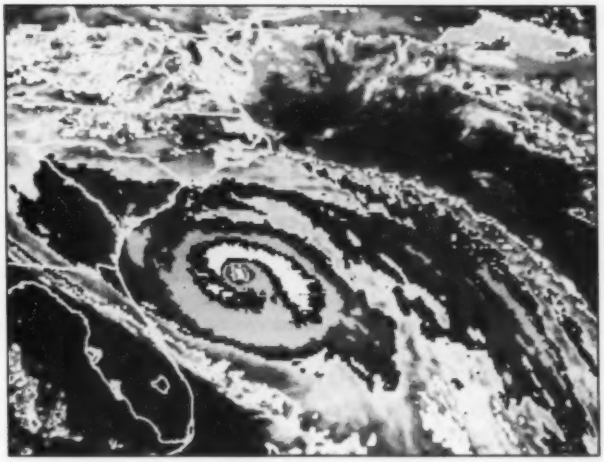
No	Intensity	Dates
01B	TS	May 23 – 27
02A	TS	June 7– 13
Gay	TY	Nov 1–10

TY – Typhoon (carried over from Western N. Pacific, where Gay originated).
TS – Tropical Storm
TD – Tropical depression

Tropical Cyclone Statistics

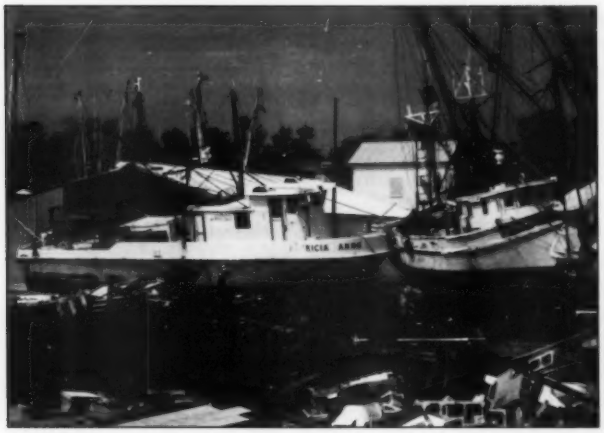


More photographs of Hurricane Hugo are are presented in this column in keeping with our tropical cyclone theme. The photographs and even the video tapes of the destruction caused by Hurricane Hugo only begin to tell the story of the most devastating hurricane in the history of the United States, in terms of damage. As coastal development continues, this will be a common occurrence in the future and Hugo will be relegated to just one of a number of destructive storms.



The photograph above is a computer-enhanced view of Hugo as it approached the South Carolina coast. It was taken on the 21st of September at the same time as the cover shot. Both were provided by John Shadid of the NESDIS Training and Information Services Branch.

Part of the Charleston, SC historic mansion district lay under water (below) after Hugo hit this coastal city. The great home were spared massive destruction and mostly received water damage. Wide World Photo.



Above is a photograph of the damage to the shrimp boat fleet at the village of McClellanville, SC. McClellanville is located on Jeremy Creek, within Bulls Bay, near the South Carolina coast. The U.S. Geological Survey measured a storm surge of 20.2 feet (National Geodetic Vertical Datum) at nearby Seewee Bay. Many large vessels that stayed offshore were swept landward by the surge. Wes Tyler of the South Carolina State Climatology Office took the picture and provided the information.

North Atlantic Weather Log October, November and December 1989

October— This transitional month usually features a weakening Azores–Bermuda High and a strengthening Icelandic Low. Conditions were pretty close to normal in 1989 (fig 1). Anomalies were about 2 mb or less except around northern Greenland, where a cold high was more intense than normal. In the upper levels (500mb) steering currents, on the average, were oriented from the west southwest toward the east northeast. Ideally a New York storm would end up over the English Channel.

On This Date

October 17, 1950— A small but powerful hurricane struck the Miami area. The storm packed winds up to 122 mph and caused $128 million damage.

Extratropical Cyclones

The month opened with a 1029–mb High off the New England coast and a 1037–mb High centered just west of Iceland. A couple of weak low pressure systems were located over the Davis St and Greenland Sea while a broad area of low pressure spanned the southwest tropics and subtropics south of 35°N. Things changed slowly as the New England High strengthened slightly as it moved eastward and became oriented in a north–south direction. A cold front trailing from a weak Low, which had formed between the two Highs, moved through the eastern Atlantic and across the European coast, from Great Britain to Portugal, by the 5th. The High continued to dominate weather in the eastern waters, while a Low was developing over the St. Lawrence Seaway. By the 7th, the New England High was drifting east northeastward toward Great Britain while another High moved off the southeastern U.S. Between these two systems was a weak stationary front with two identifiable centers.

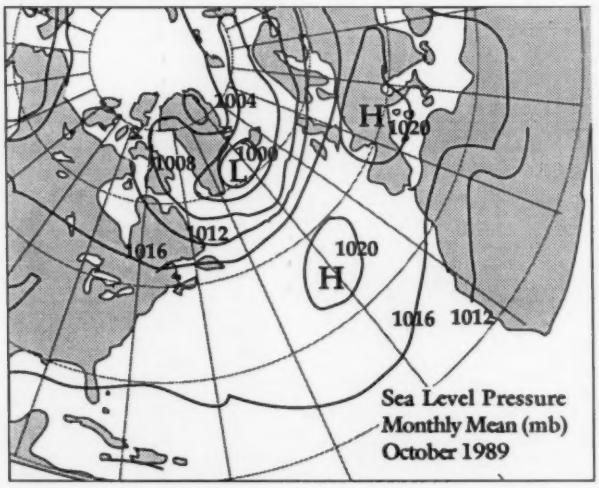


Figure 1.— A near–normal situation existed over the North Atlantic in October as the Azores–Bermuda High was weakening and the Icelandic Low was beginning to take over. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.

❶ On the 8th, a Low developed off the South Carolina coast, along a stationary front north of the southern Atlantic High. Moving rapidly northeastward the 992–mb Low crossed the 40th parallel near 62°W by 1200 on the 9th. Some 12 hr later, pressure dipped to 981 mb after the storm turned northward and clipped St. Johns Newfoundland. Vessels in the vicinity including the ***OOEL Challenge***,

Dawson, VOGT and VOCG encountered 40– to 45–kn winds in seas up to 18ft. The storm swung northeastward again, heading toward the Denmark St. By the 11th it turned eastward. The following day it moved across southern Iceland and began to weaken. On the 13th it hit the Faeroe Is.

While Storm No. 1 was nearing the Denmark St on the 11th, a large double–centered 1034–mb High was covering most of the Atlantic south of 50°N. However, on the 12th, a couple of weak low pressure centers merged off Nova Scotia.

❷ One of these centers originated over Kansas on the 9th, while the other sprang to life on the 11th some 250 mi east of Cape Hatteras. By 0000 on the 14th this combination became a well–organized system with a 980–mb pressure center located near 53°N, 40°W. At this time the ***British Ranger***, about 500 mi southeast of the center, encountered a 42–kn southwesterly in 25–ft swells. Not too many ships were close to the center, but the ***Nivi Ittuk*** was and sent in several reports on the 15th, which indicated the storm was potent. Near 59°N, 44°W she reported 52–kn winds at 0900, 60 kn at 1200 and again at 1800. Her winds were out of the north and seas were running about 33 ft with a slope of approximately 1/25— not very steep. By 0000 on the 16th her winds dropped to 50 kn and she completed an excellent series of reports in difficult circumstances. Reports were also received, at 0000 on the 15th, from ***OSV C*** and the ***Reykjafoss*** of 40– to 45–kn winds and ***OSV C*** battled 23–ft swells. The storm began to weaken on the 16th.

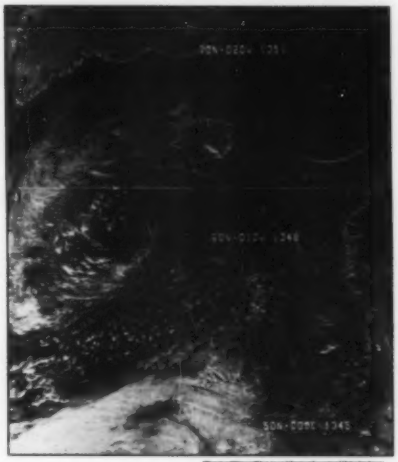
Meanwhile Hurricane Jerry had developed in the Gulf of Mexico and was threatening Texas (see pg 12), and a vicious storm was coming to life over Iowa.

❸ Developing as a wave along a stationary front, this system moved across the Great Lakes region on the 16th and accelerated to Newfoundland the following day. It came off the coast as a 999–mb Low at 1200 on the 17th and 24 hr later it was 964–mb Low, heading northeastward. It slowed on the 19th and stalled the following day, about 300 mi south of Iceland. Central pressure remained at around 960 mb through the 21st. At 0000 on the 21st, it was estimated at 955 mb. Its circulation covered the northeastern Atlantic including the Denmark St, Greenland, Norwegian and North Seas. At 1200 on the 20th, ***OSV C*** hit 45–kn northwesterlies in 26–ft seas, some 600 mi southwest of the 959–mb center. At the same time ***OSV L***, within 100 mi southeast of the center, reported a 962–mb reading but only 35–kn winds in 20–ft swells. The ***Venus Diamond***, at 0000 on the 21st, battled 33–ft swells in 55–kn northwesterlies near ***OSV C***, which was still weathering 45–kn winds.

❹ On the 19th another center started to develop to the south of Storm No. 3, along its cold front. This system moved toward Great Britain at more than 30 kn while the main system was stalled a few hundred miles to the north (fig 2). At 1200 on the 21st Storm No. 2 was creating havoc over a good portion of the eastern North Atlantic while the separate 988–mb center of No. 4 whizzed across Ireland and Scotland causing problems throughout the United Kingdom (see casualties). Torrential rains and hurricane–force wind gusts resulted in major roads being blocked by floods and fallen trees. Winds up to 99 mph were reported near Falmouth.

Meanwhile, a large 1033–mb High pushed down from eastern Ontario and settled in over the western North Atlantic. This shove moved Storm No. 3, which headed northeastward and weakened. Storm No. 4 continued northward and brought heavy weather to the Norwegian Sea on the 21st and 22d.

The High remained stationary, some 450 mi west of the Azores, on the

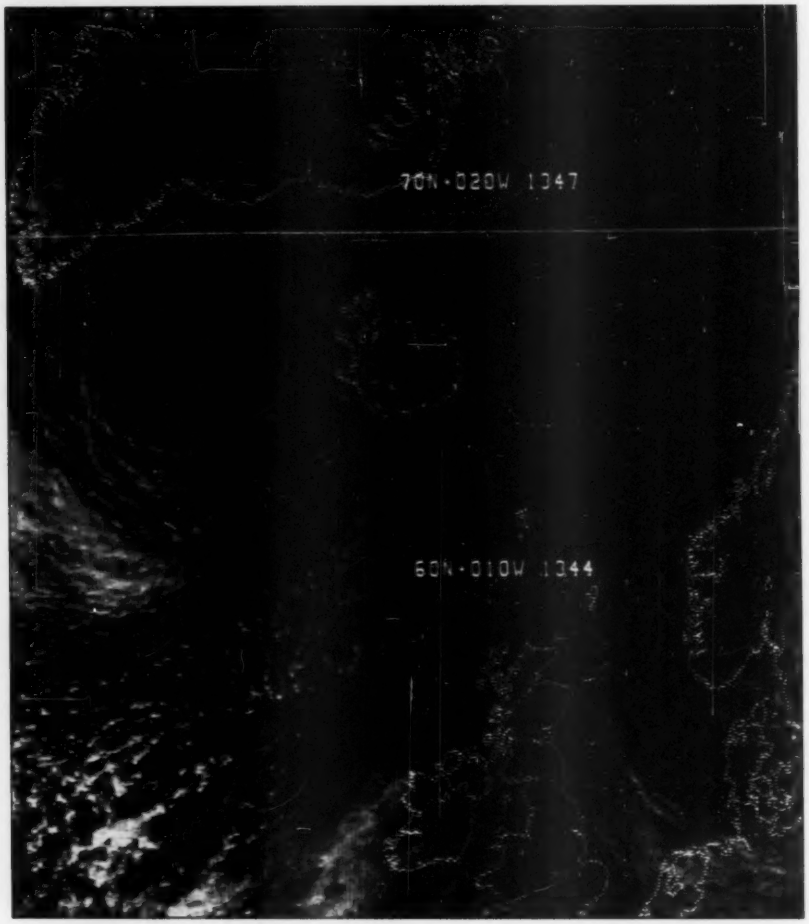


Satellite Data Services Division

Figure 2.— The outer fringes of this storm are beginning to reach Great Britain, while its parent system can be seen to the south of Iceland on the 20th.

23d and 24th. To the southwest, along a stationary front, a small wave was beginning to develop. The front originated in a 970–mb Low that had tracked past Kap Farvel on the 24th. The atmospheric wave was the real story, however, as it was soon to become the Monster of the Month.

❻ **Monster of the Month**— After coming to life some 300 mi east of the Bahamas, on the 24th, this storm headed toward the northeast at about 15 kn, developing slowly. At 1200 on the 25th, the 1001–mb Low was generating 35– to 40–kn winds close to its center. It was bucking against a 1031–mb High to the northwest, while the remnants of the previous stationary High remained to the east. This tightened the gradients considerably. At 1200 on the 26th, the ***Gulf Speed*** and the ***Mason Lykes***,



Satellite Data Services Division

Figure 3.— The Monster of the Month is seen here on the 30th at about 1345 UTC. At 0000 UTC on the 30th its central pressure had dipped to 932 mb and ships were avoiding this storm like it was the plague. By the time this photo was obtained the storm was slowing and there was a slight weakening trend apparent, although it was still potent.

west of the center, were reporting 40–kn northerlies. The ***Gulf Speed*** was fighting 20–ft seas. Still the central pressure was just 996 mb. By the 28th it began to take shape. From 972 mb on the 28th, central pressure plummeted to 939 mb during the next 24 hr. In addition, the developing monster turned northward and slowed. The storm's cold front to the east was particularly active, so most of the North Atlantic, north of 45°N, was under siege. By 1200 on the 28th, winds were running about 40 to 50 kn in 10– to 25–ft seas. Early the next day several vessels, including the ***Demyan Korotchenko*** and the ***Amke***, were encountering 52–kn winds. A key report came in from the ***Khudozhinik Repin*** (56°N, 39°W)— a 953–mb pressure. By 1200 on the 29th, things really broke loose. The Amke (53°N, 39°W) battled 33–ft seas with a 1/16 slope while the Volna (56°N, 32°W), also in 33–ft seas, hit 72–kn west southwesterlies with a 950–mb pressure. Winds at or near storm force were also encountered by the ***Damyan Korotchenko, Nivi Ittuk***, and ***OSV C.*** At 1800, winds in the 50– to 65–kn range were common as were seas of 33 to 40 ft. Heaviest weather was being reported in the western semicircle, particularly to the southwest of the center. By 0000 on the 30th, the pressure was estimated at 932 mb near 60°N, 32°W. Observations fell off as vessels avoided this monster. At 0600, the ***Amke*** and the ***Skogafoss*** both hit 60 kn winds; the Skogafoss (59°N, 39°W) had reported a 956–mb pressure 3 hr before. The monster's movement had slowed to a crawl and a weakening trend was detected (fig 3). Don't tell the ***Amke***, however, since she was encountering 60–kn winds in 43–ft seas near 53°N 39°W at 1200 on the 30th. However, the central pressure rose to 940 mb and, in general, winds were blowing at 40 to 50 kn. Seas were still wild— in the 35– to 40–ft range in some cases. By 0000 on the 31st, the 958–mb Low continued slowly northeastward and the monster retained its potency into November but was weakening rapidly.

Tropical Cyclones

The annual summary for the North Atlantic appears on pg 12 of this issue.

Casualties

The ***Margret G***, a sand barge, was driven aground on the 20th in the English Channel after nearly sinking. The ***Alston*** stood by but was unable to help in southwest gales and rough seas. The vessel was eventually refloated. On the 22d, the 22,972–ton ***Mercantil Marcah*** grounded and broke in–two near Sognefjorden, Norway.

November— A large extensive Azores–Bermuda High (fig 4) resulted in positive anomalies of up to +6 mb around Iceland while an increase in cyclonic activity off Spain caused negative anomalies of down to –6mb in that region. In general, the steering currents aloft were east northeastward with a trough apparent at longitude 15°W, which created a dip toward the southeast followed by a northeastward turn.

On This Date

November 26, 1888— A late season hurricane brushed the East Coast of the U.S. with heavy rain and gale force winds. The storm passed inside Nantucket, across Cape Cod and then crossed Nova Scotia.

Extratropical Cyclones

The month opened with a large 973–mb Low near Iceland with several subcenters embedded within its circulation and a broad 1030–mb High over the mid latitudes. One of the subcenters became a separate circulation and moved across Great Britain on the 3d while a Great Lakes Low flared up briefly in the Labrador Sea on the 2d. When it weakened it was replaced by a more potent storm.

❶ This system was originally detected on the 2d as a wave along a front over southern Georgia. Moving northeastward it developed slowly. On the 3d, it received a boost from another atmospheric wave and the following day was becoming more organized near Nova Scotia. By 0000 on the 5th the central pressure was down to 970 mb as the system turned toward the east northeast. Not too far from the center, the ***Gadus Atlantica*** hit a 51–kn southwesterly and registered a 980–mb pressure. At 1800 the ***Maksim Ammosov*** (55°N, 56°W) encountered a 52–kn northwesterly in 25–ft seas. Several other ships were reporting winds in the 40– to 50–kn range. On the 7th, the storm was moving slowly towards Iceland, while a wave was developing along its cold front northwest of Cape Finnisterre, Spain. While the parent low was nearly stationary the secondary system sped northeastward across southern England on the 8th. The small but potent system created some problems for shipping in the North Sea region (see casualties).

By the 9th an extensive 1030–mb High centered near 35°N, 35°W was enveloping a good portion of the Atlantic south of about 45°N. The two previous storms were winding down and a low from the Gulf of Alaska was headed for the Great Lakes.

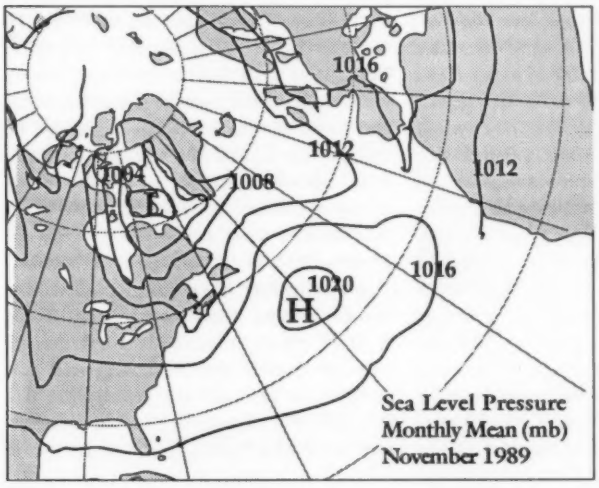
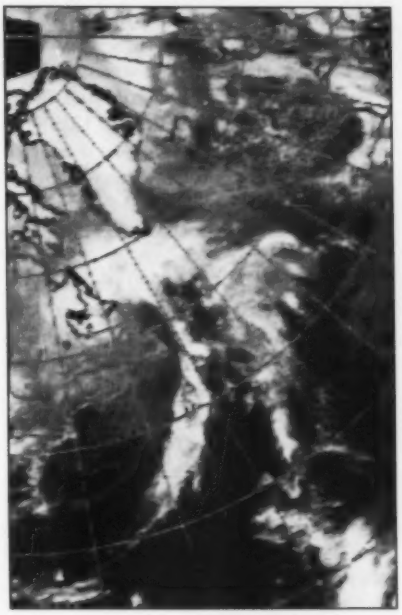


Figure 4.— The Azores–Bermuda High is quite extensive for a transition month. The Icelandic Low was to the west of its normal position but was also stronger than normal. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.



Satellite Data Services Division

Figure 5.— At about 1930 on the 4th, a storm was organizing near Nova Scotia. Its frontal system was sharply defined and trailed to the south.

❷ This storm popped up in the Gulf of Alaska on the 7th. Weakening, it tracked eastward across British Columbia, Alberta and Saskatchewan on the 8th. The following day it swung east southeastward and began to reintensify. On the morning of the 11th, the NWS at Cleveland, OH, issued its first storm report, which positioned the Veteran's Day storm midway between Lake Superior and James Bay. The system was moving eastward at about 50 kn and generating winds up to 52 kn with gusts to 60 kn on Lake Superior, about 29 mi northeast of Rock of Ages. Storm warnings were up for Superior and gale warnings for the other lakes. These conditions continued during the day as the center passed north of the region. At 1800 (1 p.m. EST) gales

were prevalent across Lake Superior, while vessels were reporting seas of up to 13 ft. Gale warnings were lowered over southern Lake Michigan at 2000. Late in the day (0000 on the 12th) the 984–mb Low was positioned east of James Bay and moving toward the east northeast at 25 kn. Gale warnings remained in effect over Lakes Superior, Huron, Erie and Ontario. Between 2100 on the 11th and 0000 on the 12th, several vessels encountered winds in the 40– to 50–kn range with seas of 5 to 13 ft. The vessels included the ***Delaney*** and the ***William Roesch***. The last report was issued late on the 11th as the storm began to move out of the region. However, it was not finished.

Once off Labrador, on the 13th, central pressure dropped slightly to 980 mb. By 1200 on the 14th it was estimated at 967 mb off southwestern Greenland. The ***Sidelia*** (50°N, 42°W) hit 40–kn westerlies in 20–ft seas while the CGBK (67°N, 59°W) was nailed by 44–kn north northwesterlies. The spurt was short–lived, however, and the system moved northward along the Greenland coast and weakened.

The large double–centered High continued to occupy much of the Atlantic south of 45°N from the 14th through the 17th. On that date a Low developed over northeastern waters.

❸ This storm developed along a front near 54°N, 27°W on the 17th. It headed south southeastward and became a well–organized 976–mb system by 1200 on the 18th. Several ships were running into 45– to 50–kn winds at 0600, including the ***Theodore Storm***, ***Pytchley***, ***Neerlandic*** and ***Concert Express***. The ***Alemania Express*** (50°N, 24°W) hit 60–kn northerlies in 40–ft seas. By 1200, no less than two dozen ships were reporting winds in the 40– to 60–kn range. At 0000 on the 19th, central pressure was estimated at 968 mb and the circulation dominated a good portion of the eastern North Atlantic. The ***Alemania Express*** was battling 55–kn northerlies while the ***Author*** penned

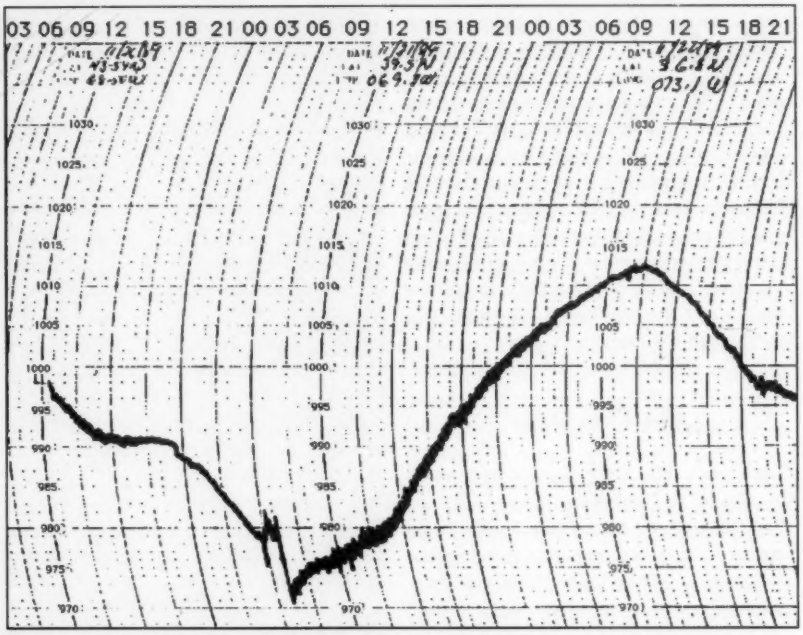


*Figure 6.— The MT **Delaware Trader** from Penobscot Bay, ME to Houston, TX ran across Storm No. 4 on the 20th and registered this barograph trace.*

60–kn northwesterlies in swells estimated at 40 ft. Later in the day the system began to let up, but storm and gale force winds continued to plague the area until the 20th.

❹ Meanwhile, another system that had formed in the Gulf of Alaska made its way across Canada and into the Great Lake region. At 0300 on the 20th the NWS Forecast Office at Cleveland found a 992–mb center near Lake Nipigon, Ontario. From there it headed southeasterly and ended up near Lebanon, NH, 24 hr later at 980 mb. The first storm report was issued by NWS Cleveland at 1700 on the 20th. During the previous 3 hr, highest winds were registered over Lake Superior, some 12 mi west northwest of Manitou Is, where 50–kn north northwesterlies were blowing with gusts to 68 kn. Storm warnings were up for all the lakes, except for gale warnings over the southern half of Lake Michigan. During the next several hours a 60–kn wind was reported on Lake Michigan, some 35 mi northwest of Grand Traverse Light and a 53–kn report came in on Lake Huron about 33 mi west of Detour Reef Light. The storm continued to intensify slowly. Between 1900 and 2200 on the 20th, a 46–kn wind with gusts to 55 kn occurred on Lake Erie (41.8°N, 82.5°W), while on Lake Huron winds gusted to 73 kn 16 mi north of Thunder Bay Is Light. Sustained gale and storm force winds continued as the system headed toward the coast. Storm warnings remained in effect over Lakes Huron and Ontario and eastern Superior at 0430 on the 21st. A 70–kn north northwest wind had been recorded by the ***George A. Stinson*** (43.6°N, 82.6°W) at 0300, while the Rochester Coast Guard felt the sting of 50–kn northwesterlies at 0200. By 0700 on the 21st the 974–mb center was just east of Portland, ME, and the system was intensifying rapidly (fig 6). By 1200 the 964–mb center was heading for Nova Scotia, but then turned

abruptly northward. In combination with a center over the Hudson St, the tight circulation stretched from Baffin Bay south to about 30°N. The intensity of this storm was reflected in the ship reports. At 0600 the ***Neftegorsk*** (48°N, 63°W) was racked by 66–kn northerlies and recorded a 964–mb pressure. As far south as 35°N, 60°W the ***Actuaria*** accounted for 52–kn west northwesterlies while struggling in 33–ft seas at 1200. In general, winds ranged from 40 to 60 kn from west of about 55°W to 70°W. The system finally weakened on the 23d.

The weather pattern on the 24th was rather messy with a number of low pressure systems scattered across the North Atlantic including a 976–mb Low off New England, which was creating a few headaches along the shipping lanes.

❺ Relatively unnoticed, was a Low that had formed off San Francisco and made its way across the country. Its first blow to marine traffic was on the Great Lakes on the 27th and 28th. The first storm report was issued by NWS Cleveland at 0415 on the 28th and it pinpointed the 991–mb center near Saginaw Bay. At 0300 Stannard Rock, MI, (Lake Superior), reported a 42–kn wind while Ottercliffe Hall on Lake Erie reported a 58–kn west southwesterly. From 0400 to 0700 gales were reported on Lakes Superior, Huron, Erie and Ontario, and storm warnings continued on Huron, Erie and Ontario. By 1000 on the 28th, the 992–mb center was located 25 mi southwest of Muskoka, Ontario, and moving east northeastward. By 1630, the storm was just west of Montreal and winds over the lakes were not quite as strong, although gale warnings remained in effect. Early the following day, this system swung northeastward and resumed intensifying. By 1200 on the 29th, the 975–mb center was moving through the Gulf of St. Lawrence. It continued to deepen. At 1800 the ***Imperial Acadia*** (49°N, 64°W) ran into 45–kn north northwesterlies. Reports were mainly of 40– to 45–kn winds through the 30th, although at 1200 the ***Johan Petersen*** (55°N, 56°W) ran into a 52–kn blow in 26–ft seas, with a slope of about 1/20. The system began to fill slowly on the 1st of December.

While Storm No. 5 was moving into the Labrador Sea, Tropical Storm Karen was coming to life in the Gulf of Mexico. In addition another Low flared up briefly over the Great Lakes on the 30th. It didn't look like too much on the weather charts, but the vessels on the Lakes told a different story. At 1800 on the 29th, five vessels on Lake Superior reported winds in the 40–to 50–kn range in 10–ft seas. Among these ships were the ***Eastern Shell*** and the VCTN. By 0000 on the 30th, winds in this range were being encountered by vessels on northern Lake Michigan and Lake Huron as well. By 0600, they had spread to Lake Erie as the storm continued. For example, the VGFJ (42.0°N 81.6°W) hit 48–kn west southwesterlies while nearby the VCQJ ran into 45–kn westerlies. However, by 1200 the ship reports made it apparent that this was just a short–lived intensification.

Tropical Cyclones

See the annual summary on pg 12 of this issue.

Casualties

On the 8th, the self–elevating drilling platform ***Interocean II*** overturned and sank in the Dutch Sector of the North Sea (near 53.5°N, 03.3°E). A tow rope had parted from one vessel but it remained tied to another. At the time it was reported that winds were 50 kn and seas were rough. On this same day on approach to the River Elbe, a collision occurred between the ro–ro ferry ***Hamburg*** and the ***Nordic Stream***. The ***Hamburg*** was holed beneath the waterline on the starboard quarter. Three people were killed and 15 injured. Visibility was good at the time, although it was reported that winds were gusting to 60 kn across the channel and seas were 7 ft.

December— It was the worst of times, it was the worst of times. It was a month of monster storms. Any mariner that rode the North Atlantic could proudly wear a T-shirt

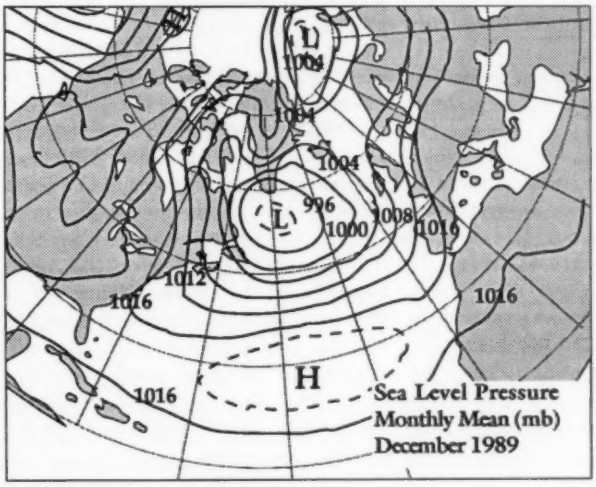


Figure 7.— The Icelandic Low off southern Greenland is an indication of the severity of this month. It resulted in a 16 mb anomaly at the center and –6 to –14–mb deviations covered most of the North Atlantic, north of 30°N. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.

stating— **I survived the North Atlantic in December, 1989.** It was that bad. How bad was it? The Icelandic Low usually about 1000 mb in December was off Kap Farvel at 992 mb (fig 7). The whole North Atlantic from 20°N to 60°N was covered by negative anomalies. They were highest near 45°N, 20°W where they reached –16mb; that is an incredible deviation from normal. Steering in the upper levels was nearly zonal west of 30°W and then curved northeastward to the east of 30°W.

On This Date

December 16, 1835— New England experienced one of their coldest days of record. At noon on that bitterly cold Wednesday, the mercury registered –4°F at Boston and –17°F at Hanover, NH. Gales blew out of the northwest through the day and that night a great fire in New York City destroyed much of the financial district.

Extratropical Cyclones

It began as a fairly normal month except for Tropical Storm Karen's appearance in the eastern Caribbean. A large 1042–mb High covered most of Europe and the eastern North Atlantic. A couple of moderate low pressure systems were creating minor headaches over western waters.

On the 2d, a storm report was issued for the Great Lakes as a slowly intensifying 997–mb Low was spotted 25 mi west of Wiarton, Ontario. Winds across the lakes were running about 35 to 50 kn at their worst, around 1700. At 2348 Copper Harbor, MI, on Lake Superior, registered a 46–kn north northwesterly with gusts to 59 kn. NOAA Data Buoy 04 was recording 13–to 14–ft seas around this time. The storm weakened somewhat during the night (local time) but early on the 3d, a new center began to develop off New Jersey. Eventually this became the dominant circulation as it reached New England waters, then moved northward across Nova Scotia and into Labrador.

❶ This storm came to life on the 6th over southern Michigan, remaining south of the St. Lawrence Seaway as it headed toward New England. It reached New Brunswick as a 992–mb system at 1200 on the 7th. The storm continued to intensify as it crossed the Gulf of St. Lawrence. At 1200 on the 7th, the ***ASL Cygnus*** off Cape Ray, Newfoundland reported 40–kn south southeasterlies, while 6 hr later the VGXB (46.3°N, 64.0°W) hit 50–kn west northwest winds. The ***Irving Nordic*** at 0000 on the 8th ran into 50–kn winds out of the northwest, off Halifax, Nova Scotia, and was reporting 47–kn wind 6 hr later. The VCYL, in the Gulf of St. Lawrence, encountered 45–kn northwesterlies at 0600 on the 8th, which increased to 65 kn by 0600 on the 9th. By this time the storm's central pressure was approaching 964–mb as it headed eastward. However the storm ran into a block on the 11th and its center made a counterclockwise loop, which kept it over the northwestern North Atlantic for an extra few days. Not only that, it reached a peak intensity of about 952 mb on the 11th at 1200. Both the ***Naja Ittuk*** and the ***Gigant*** ran into winds of more than 50 kn at this time and the ***Gigant*** (49°N, 43°W) was battling 30–ft seas. On the 12th, as the center edged back to within about 250 mi of southern Labrador, the Gulf of St Lawrence was pounded again. At 1200 the VRKA reported a west northwest 60–kn wind in 30–ft swells; 6 hr later the ***Irving Arctic***, now in the Gulf, was hit by 50–kn winds in 20–ft seas.

The storm was starting to fill as it completed the loop on the 13th. However, on the 15th it became part of the circulation of the monster of the month. Under ordinary circumstances this storm would have qualified as monster, but this was no ordinary December. See Casualties for more details.

❷ **Monster of the Month**— It began as an atmospheric wave off the Texas coast on the 7th. A ridge of high pressure over the central U.S. confined it to a coastal route as it moved in an easterly direction. It came off the northeast coast of Florida, on the 9th, as a 1005–mb Low. The following day it had organized into a recognizable circulation with a 985–mb center that was heading toward the east northeast. At this time, however, the system was completely overshadowed by Storm No. 1 east of Labrador. The monster bided its time and took the spotlight on the 13th as it began to turn a counterclockwise loop after crossing 50°N near 17°W.

At 0000 the ***Patty*** (47°N, 15°W) hit 45–kn southwesterlies while 6 hr later the 9VII (52°N, 13°W) was buffeted by 47–kn winds in 20–ft seas. At 1200, the ***Nedlloyd Holland***, just northeast of the 964–mb center, radioed 55–kn north northeast winds and a 961 mb pressure— lower than the estimated central pressure. This was a potent storm that had yet to reach its peak. Of course, vessels were now taking every precaution to steer clear so reports began coming in from the periphery instead of the heart of the system.

By 1200 on the 15th the 960–mb storm completed its loop and headed eastward, then northeastward toward Ireland (fig 8) and the bottom dropped out. By 1200 on the 16th the central pressure had plummeted 18 mb to 942 mb— this same pressure was measured by an unidentified vessel at 0000 on the 16th. At the same time another ship, some 500 mi to the south, was battling 30–ft swells. Swells of 33 ft were reported 180 mi to the

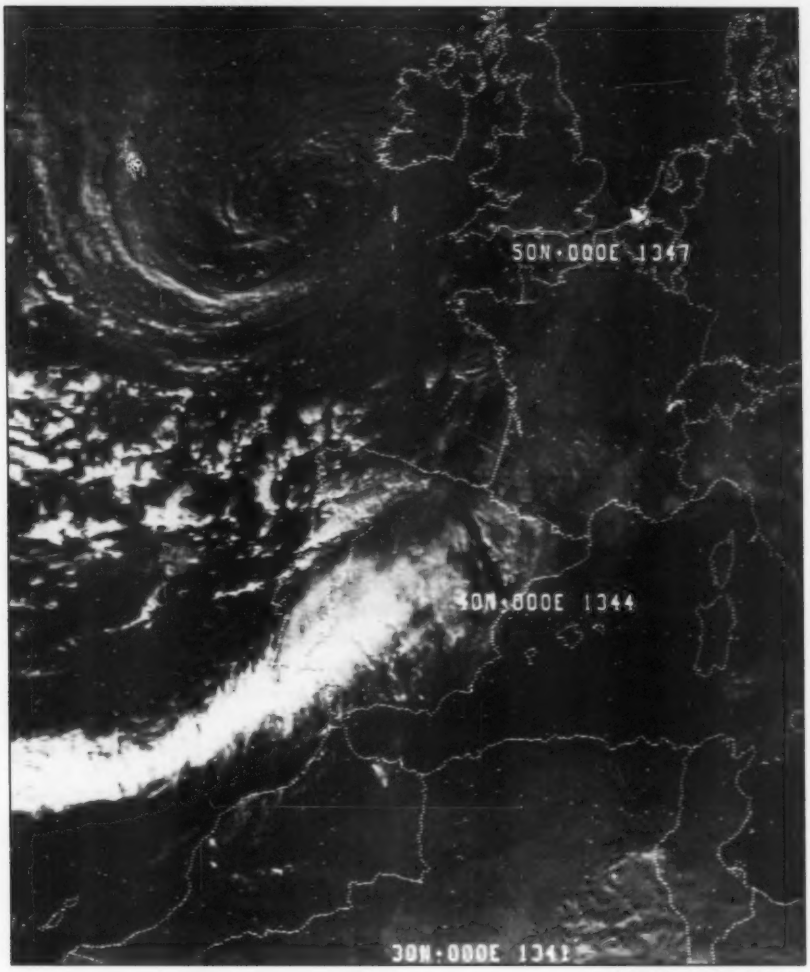


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Figure 8.— The Monster of the Month is seen at 1350 on the 16th. Just a few hours before the central pressure was estimated at 942 mb. Note the strong bright band of clouds that represents the system's cold front, which is already over the Iberian Peninsula and approaching the northwest coast of Africa.

east at 1200, while some 300 mi to the southeast a ship hit 50–kn southwesterlies in 23–ft swells. The ***Izumrudngy Bereg***, at 0000 on the 17th, was nailed by 50–kn south southwesterlies in 33–ft swells about 300 mi south southeast of the center, which was over Iceland. Conditions were rough from the North Sea to the Bay of Biscay (fig 9). In addition, the associated cold front extended from western Europe to the Canary Islands. The following day a separate center, which had formed on the 16th to the west, moved into the English Channel adding to the weather problems. The main system moved across Ireland and into Scotland on the 17th, crossing the North Sea the following day. By 2300 on the 18th, the 960–mb center was near Bergen, Norway. The 6BXW reported a west wind at 65 kn near 58°N, 1°E, but, in general, vessels in the North and Norwegian Seas were fighting 40– to 45– kn winds. See the casualty section for details on the tremendous problems this storm created.

The 17th of December presented a complex weather pattern over the North Atlantic and North America. In addition to the monster moving across Scotland and the secondary system heading for the English Channel, there was an intensifying storm over Cape Breton Is and an incipient Low just east of Winnepeg, Manitoba that would prove to be the most intense storm of the month. The Cape Breton storm, which had originated over Colorado on the 11th, (a Colorado Rocky Mountain Low), headed eastward and continued to intensify. By the 19th, at 0000, its central pressure had dipped to 960 mb and it was threatening Western Europe a few days after the last devastating weather attack. The GJPP (47°N, 29°W) reported a southeast 60–kn wind and a 972–mb pressure at 0000 on the 19th. The center reformed, or merged with another system, but in any case the storm turned northeastward averting a direct blow to the Continent. However, the 970–mb center passed close to the Hebrides on the 21st. The system still produced rough weather for shipping during this period. At 1200 on the 20th, the ***Humboldt Express*** ran into 60–kn southwesterlies while battling 30–ft swells. Storm force winds were reported by the GBXW, ***Euro Louisiana***, and the ***Ludwigshafen Express***. These conditions continued into the 21st. Meanwhile, the Winnepeg whizzer was making its way into the Atlantic.

❶ The Winnepeg storm reached the Gulf of St. Lawrence on the 21st as a 988–mb Low. By 1200 on the 22d its central pressure was estimated at 954 mb— a very potent storm. It slowed considerably as it turned toward the northeast. The ***Atlantic Compass*** (51°N, 38°W) felt the sting of this system, at 1200 on the 22d, when it was belted by 60–kn west southwesterlies while reel-

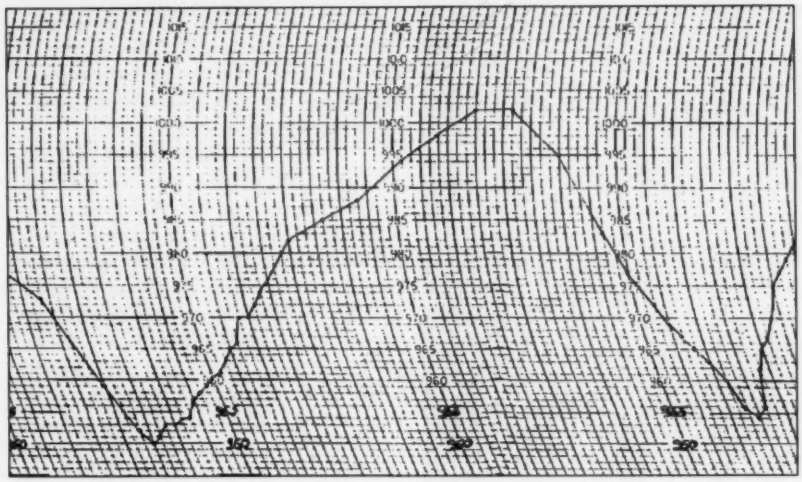

Figure 9.—This barograph trace from the Sea–Land Performance reflects the weather that was encountered by many ships during December. On the 16th near 57°N, 20°W pressure bottomed out at 950 mb and then late on the 18th it dropped to 954 mb as the vessel made its way from Roterdam to Charleston, SC.

ing in 36–ft seas. The air was a balmy 3.4°C, so you can imagine the wind chill. Several other vessels were reporting storm force winds including the ***Dusseldorf Express*** and the ***Ael Europa.*** The 23d brought no improvement to the shipping lanes as the storm crossed the 55th parallel near 40°W. Seas of 15 to 30 ft were common as were 45– to 55–kn winds. At 0900 ***OSV C*** (52°N, 37°W) reported a 966–mb pressure while the ***Nuka Ittuk*** recorded a 964–mb reading near 59°N, 40°W. Just when it looked like things couldn't get any worse, they did. The storm really intensified. By 1200 on the 24th, the central pressure was estimated at 930 mb, the central pressure of Hurricane Hugo when it hit the South Carolina coast. This may be the only time in the history of the Mariners Weather Log that a storm of this intensity was not the Monster of the Month. But then this was a month of monsters. One saving grace was that this storm was at a fairly high latitude by this time— but not out of harm's way by a long shot. Its circulation was responsible for gales near 40°N and it effectively blanketed the northern shipping routes from the Grand Banks to England. At 0600 on the 24th, for example, more than two dozen vessels radioed in with winds in the 40– to 60–kn range. At 1200, 20 ships had storm force winds (50 kn or more). Swells were being estimated at up to 50 ft. The North Atlantic was boiling! At 59.4°N, 35.1°W the ***Skogafoss*** measured a 951–mb pressure— and this was more than 300 mi from the storm's center. This severe pounding continued throughout the 24th as the storm moved slowly away from the main shipping lanes. While there was a noticeable improvement on the 25th, it was still no picnic out there. In fact, it wasn't until the 26th that things died down to gale force. And this was a respite that would last just a few days.

❶ On the 28th, a Low was developing off the Outer Banks of North Carolina that would bring December and 1989 to a crushing finale. However, on that date it wasn't the main concern of shipping. A Low that had formed near Edmonton, Alberta on the 24th had just exploded after moving into the North Atlantic off Newfoundland. At 1200 on the 28th, its 958–mb center was just off Kap Farvel and its circulation was menacing the shipping lanes. At 0000 on the 28th, the ***OOCL Challenge,*** near 53°N, 40°W battled 28–ft seas in 50–kn southerlies. This was typical of the reports received on the 28th and 29th as the system moved northward into the Denmark St.

By this time the Cape Hatteras storm was moving in to replace it. On the 29th at 1200, its 976–mb center was crossing the 45th parallel near 45°W. Some 24 hr later, the storm was approaching the 55th parallel as a 940–mb monster. At 1200 on the 30th, ***OSV C*** was just a short distance southeast of the center and provided the key observation. She reported a 946.5–mb pressure while trying to maintain control in 46–ft swells. As the New Year arrived, the storm did weaken rapidly near Kap Farvel. It was soon replaced by a 956–mb Low on the 3d of January. But that's another story.

Tropical Cyclones

None formed in December but Karen made a brief appearance in the beginning of the month. See the annual summary on pg 12 for details.

Casualties

Storm No. 1 caused disaster in the Gulf of St. Lawrence. The ***Capitaine Torres,*** with a crew of 23, sent out a distress signal after the cargo shifted and some containers slid overboard. A message was received that they were abandoning ship some 29 mi north of Cape North, Cape Breton Island. Winds of 50 kn with 25–ft seas and icing made search and rescue missions difficult in the Gulf of St. Lawrence. A Canadian Coast Guard Cutter spotted the liferaft on the morning of the 8th. As they were maneuvering into position for the rescue, two huge waves overturned the raft sending the crew to their deaths in

ferocious seas as the rescuers watched helplessly. A distress signal was received from the ***Johanna B.*** some 150 mi northeast of Prince Edward Is on the 7th. After a search for the 16–member crew, all that was found was two empty liferafts some 47 mi south of Anticosti Is. In another tragedy the ***Johnny and Sisters II***, with 8 people onboard, is believed to have sunk about 175 mi southeast of Cape Race, Newfoundland on or before 0800 on the 9th. The crew may have abandoned ship after a MAYDAY. There were no signs of survivors, although one body was found in blinding snow and storm force winds.

The storms that hit Great Britain, France, Spain and Portugal from the 16th through the 25th were devastating to maritime interests. It is believed that 14 people died at sea and on land over the weekend of the 16th and 17th. Gales sweeping Ireland's southeast coast caused major damage to the fishing fleet at Kilmore Quay in County Wexford. At least 12 trawlers were destroyed, 70 fishing vessels sustained some damage and part of the pier was washed away on the 16th. The ***Destiny*** sank off Gourock Pier, in the Firth of Clyde, in heavy seas and driving snow. This occurred just 300 yd from the pier and six people are missing. That same evening the lighthouse on the Isles of Scilly was washed away as winds gusted to 85 kn. At Rosslare, in the Irish Republic, a linkspan bridge was ripped out and deposited upside down in the harbor. The frigate Plymouth, now a museum, ripped loose from her moorings at Millbay Docks, Plymouth. She was eventually rescued by four tugs from the Royal Maritime Auxilary Service after her volunteer crew of three had been winched to safety.

Things were no better farther south on this weekend. A French cameraman was killed filming storms when his car was swept into the sea at LeConquet in Brittany. A golf clubhouse collapsed 30 mi west of Paris killing one person and injuring nine. A man was missing after being swept away by waves after he tried to rescue his dog at St. Pierre, a port in Normandy. At least two people were reported killed in northwestern Spain. At sea the ***Baitin*** sank on the night of the 17th about 1 mi from Punta Insua, off northwestern Spain. Seven crewmen were saved, four were lost. The ***Arklow Victor*** developed a heavy 40° list near 47.5°N, 4.8°W. The crew was picked up by helicopter. Five crewmen were saved but it was reported that the Master was washed overboard. The ***Julia Del Mar*** lost 30 containers overboard on the 16th, off the Brest headland after losing steering in heavy weather. The crew had to be rescued by helicopter after the vessel developed a severe list. The ***Alwahda*** anchored in Cascais Bay, just north of Lisbon, slipped anchor and was driven aground. The crewmen were rescued. Late on the 15th, the sand barge ***Bacalhau*** capsized and sank in the Tagus River (Spain). One crewman was saved, but four died. The ***Marine*** was reported missing along the Portuguese coast in stormy seas 11 days after leaving Liverpool for Seville. Ships too numerous to mention suffered damage of some sort during this tragic weekend.

On the 19th the Portuguese frigate ***Comandante Roberto Ivens*** picked up two French yachtsmen and a Polish crewman in stormy seas. They had spent 23 hr in a liferaft after abandoning their yacht, which sank after being dismasted. On the 24th, the ***Toseur*** sank 11 mi south of Cape Finisterre. Its 14 crewmen were rescued.

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North Pacific Weather Log October, November and December 1989

October— The outstanding climatic features this month were the stronger than normal subtropical high along with the westward extension of the Aleutian Low (fig 1). These two circumstances resulted in a fairly tight pressure gradient across the northern shipping lanes, which generally indicates rougher–than–normal conditions. The anomalies ranged from a +4 mb over the central Aleutians and southward to a –8 mb over the western Bering Sea.

The upper, steering levels indicated a flow toward the east northeast from Japan to about 160°W with a cyclonic, northeastward turn east of 160°W. In this idealized situation a storm from Tokyo would end up over Northern California.

On This Date

October 3, 1671— First recorded mention of a typhoon affecting Guam: "Eye passed directly over island, with most of the homes on the island toppled, as well as the church and rectory suffering the same fate. A great many people were killed by falling debris and inadequate shelter while the damage to agricultural crops was a serious loss to the people."

Extratropical Cyclones

As the month began, Angela had just reached typhoon strength in the Philippine Sea. A large 1031–mb High was dominating a good portion of the central North Pacific, while Hurricane Raymond was loitering southwest of Baja California. Two moderate Lows filled the Bering Sea. On the 2d, tropical storm Colleen entered the picture, in the western North Pacific, while the westernmost Bering Sea Low became Storm No. 1.

❶ The storm was picked up on the 1st over Mys (Cape) Olyutorskiy in the Bering Sea. By 1200 on the 3d, central pressure was 968 mb and the circulation had expanded to influence the weather along the northern shipping lanes. One of the Rat Islands reported a 973–mb pressure in 40–kn winds, about 100 mi southwest of the center. The ***Prostor*** (61°N, 173°E) hit 54–kn northwesterlies while the WS625,

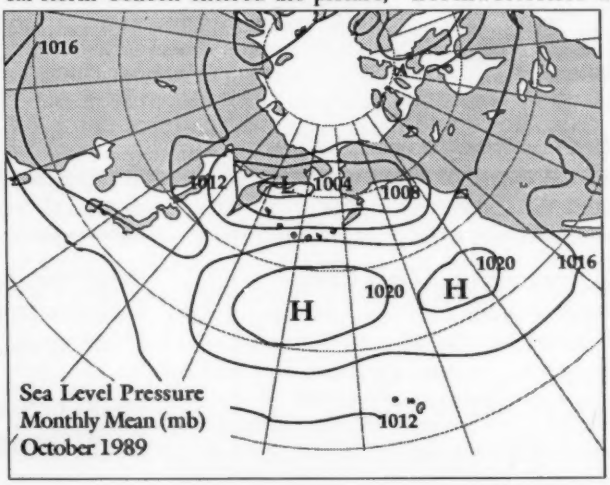


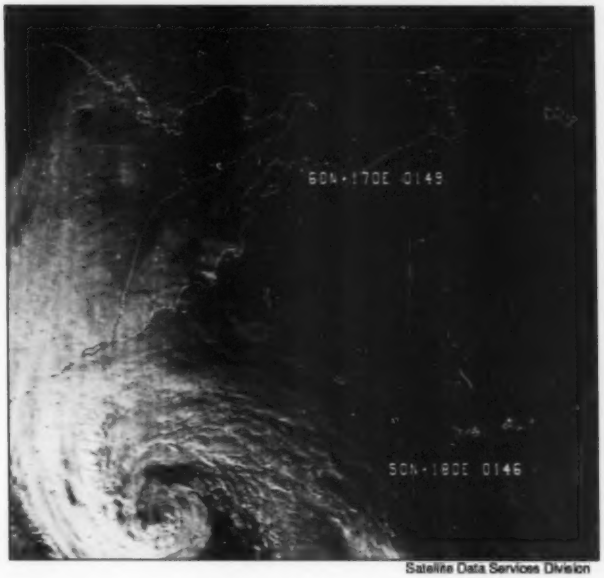
Figure 1.— The subtropical high is reminiscent of summertime conditions, but the Aleutian Low is a grim reminder of the coming winter season. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.

Kapitan Makatsariya and ***Aleksey Stakhanov*** encountered 40– to 43–kn winds. Gale reports continued through the 4th as the storm moved across the Bering Sea. On the 5th, the system moved into the Gulf of Alaska and began to fill.

By the 6th, Colleen and Angela were both typhoons but Raymond had weakened in the east. A trough was creating weather in the Hawaiian Islands while a large high pressure area remained centered in the central Pacific. A frontal system to the west of this High was about to pick up a hitchhiker— Typhoon Colleen, whose extratropical remnants would assist Storm No. 2.

❷ Colleen turned extratropical on the 8th while another Low was developing to the north over the Sea of Okhotsk. The remnants of Colleen entered the circulation and by 0000 on the 9th the storm had a 964–mb center with a large circulation. By 1200 central pressure had dropped to 956 mb. An accurate picture of the storm was painted by the ***Prostor, Malki, Karskoye More, Khotin, Boris Tsindelis, Vitya Sitnitsa, Globus, Mys Yucline,*** and the ***Krasonyarsky Komsomolets.*** These vessels reported winds in the 40– to 50–kn range in seas of 10 to 25 ft. The ***Mys Yudina*** recorded a 958–mb pressure just northwest of the storm's center. On the 10th, the storm began to fill as it made its way across the Bering Sea. Ship reports diminished as it weakened and reached higher latitudes. However, on the 11th, it turned toward the east southeast and crossed the Alaska Peninsula as a 993–mb Low.

On the 12th high pressure dominated the mid latitudes with Storm No. 2 in the Gulf of Alaska, a Low developing over the western Bering Sea and a weak low pressure system off Honshu. Except for the development of Tropical Storm Elsie in the Philippine Sea, there was little change in the patterns over the next several days. On the 16th, a weak Low formed along a front over Hokkaido and flared up briefly as Storm No. 3.



Satellite Data Services Division

Figure 2.— Former Typhoon Forrest makes a good looking extratropical storm on the 30th at about 0200. The central pressure was down to near 952 mb and dropping. As a typhoon, Forrest intensified after passing Guam and its maximum winds climbed to 95 kn before it recurved.

❸ It wasn't until the 17th, as the storm crossed the 50th parallel heading northward, that it began to organize. However by 0000 on the 18th its central pressure was 968 mb and vessels to the south were experiencing 45– to 55–kn winds in 13– to 15–ft seas. The ***Feliks Kon,*** just north of the center, ran into a 62–kn east northeasterly and measured a 975–mb pressure; to the east the ***Vadim Popov*** hit 52–kn winds. The ***Anatoliy Kolesnichenko,*** some 400 mi to the southeast, reported 52–kn south southwesterlies. However, the storm was beginning to weaken during the day as it headed rapidly northeastward. Meanwhile, approaching the Philippines on the 19th, Elsie was attaining super typhoon strength. In the eastern waters a tropical depression had come to life and was centered near 18N°, 120°E. A 1032–mb High was persisting in the mid latitudes. During the next few days the High built to 1038 mb and a Low developed off Tokyo and headed northeastward along the western periphery of the High. By the 21st, it was a 976–mb storm pushing into the western Bering Sea. In the tropics, Tropical Storm Forrest was spotted near the Caroline Islands on the 22d. By this time the 976–mb storm was approaching the Bering St, while another low pressure system was coming to life east of Tokyo.

❶ By 0000 on the 25th, this storm had a 980–mb center that had crossed the 50th parallel near 160°E. Its tight circulation was responsible for winds in the 45– to 55–kn range from such vessels as the ***Uni Spring*** (47°N, 161°E) and the ***Toyofuji No. 14*** (47°N, 165°E). The ***Fiducia*** (44°N, 165°E) hit a 55–kn westerly in 23–ft seas and 30–ft swells. The sea had a slope of about 1/10, which is fairly steep. These conditions continued through the 25th as the storm crossed the 55th parallel and began to weaken. At 1200 the ***Westwood Cleo*** (54°N, 170°E) battled 50–kn southerlies. The following day the system turned eastward and continued to dissipate.

Meanwhile, Forrest had become a typhoon but recurved before reaching the Philippines. On about the 29th it was decided that the storm was extratropical— but not finished.

❺ Forrest's remnants became a 972–mb Low at 1200 on the 29th as they crossed the 40th parallel near 160°E. By 0000 on the 30th, the central pressure of this Low was down to 952 mb; by 1200 it was at 943 mb— the most potent storm of the month. No less than 25 vessels radioed in at 0000 to confirm winds in the 40– to 55–kn range in seas of 10 to 20 ft. The same thing occurred at 0600, except a couple of ships hit 60–kn winds, namely the ***Orchid*** and the ***Hawk Arrow***. It was obvious by looking at the weather charts for 1200 on the 30th and 0000 on the 31st, that ships were avoiding this storm like it was the plague. Wind reports were running in the 40– to 50–kn range on the outskirts of this potent storm. At 0000 on the 31st, the ***Mizukawa Maru***, 300 mi northeast of the 955–mb center, reported a 72–kn east northeast wind, but most wind reports were in the 40–to 50–kn range. The lowest reported pressure at this time was 982 mb near 45°N, 164°E or about 300 mi southwest of the center. So the gradient was very tight within 300 mi but ships were scarce. The 982–mb pressure report was made by the ***Hassan Merchant***. While this storm had all the makings for the Monster of the Month its ferocity was short–lived. By the lst of November it was filling rapidly as it continued toward the northeast.

On This Date

November. 20, 1693— "In 1693 a terrible typhoon occurred. It began at dusk on the night of November 20 with a deluge of rain. The wind moved from north to south and whipped up the sea in such a manner that it seemed as if the island of Guam would be submerged. The sea broke its bounds and spread inland taking trees, houses and churches with it. Even the fortress at Agana toppled and was washed away."

Extratropical Cyclones

The month opened with a 972–mb Low, which was the last stages of a vicious October storm heading for the Alaska Peninsula. To the west were a couple of weak low pressure systems, one off Honshu and the other off Sakhalin. The Sakhalin storm did intensify briefly on the 3d and 4th, creating some problems over the northern shipping lanes. At 0000 on the 3d, several vessels including the ***Hanei Sky***, ***Neptune Diamond***, ***Mys Tikmiy***, ***President Polk*** and the ***River Star*** ran into 40– to 50–kn winds. The ships were to the south of the center. Gales continued into the 4th but then the system began to weaken. By the 5th, it became one of several weak centers between the Kamchatka Peninsula and southeast Alaska.

At 0000 on the 8th, a Low, which was to become North Atlantic Storm No. 2, was generating 40– to 45–kn winds in the Gulf of Alaska and the northeastern North Pacific. Reporting vessels included the ***President Madison***, ***B.T. San Diego*** and the ***Triton Highway***. Seas were running 10 to 20 ft. These reports continued through the day as the storm made its way inland. A complex system remained in the area for the next several days. A large 1039–mb High situated itself over the eastern North Pacific on the 11th. Another High moved in over western waters forcing most of the cyclonic activity north of 50°N for a short time. However, on the 14th two storm systems organized— one near 45°N, 155°W and another in the Sea of Okhotsk.

❶ The Sea of Okhotsk storm was first detected on the 13th. By 1200 on the 14th, the central pressure was 987 mb, while 24 hr later it was down to 958 mb. At 0000 on the 15th, the ***Triton Highway*** (53°N, 163°E) ran into 58–kn southwesterlies in 20–ft swells, while the ***XXVI Sezo KPSS*** (56°N, 172°E) was blasted by 52–kn southerlies in 20–ft seas. Several other ships were running in 20– to 25–ft seas while being buffeted by 40– to 50–kn winds. At 0600 and

November— By this time the Aleutian Low is usually the dominant feature on the Pacific climatic chart. This month (fig 3) the subtropical high made a surprisingly strong showing, resulting in positive anomalies of up to 12 mb over the Aleutians and 6 mb off the Pacific northwest coast. The Aleutian Low did prevail in the Gulf of Alaska. The 500 mb flow in the upper atmosphere indicated that, in general, storms should move east northeastward over the western North Pacific turning toward the northeast at about 165°W.

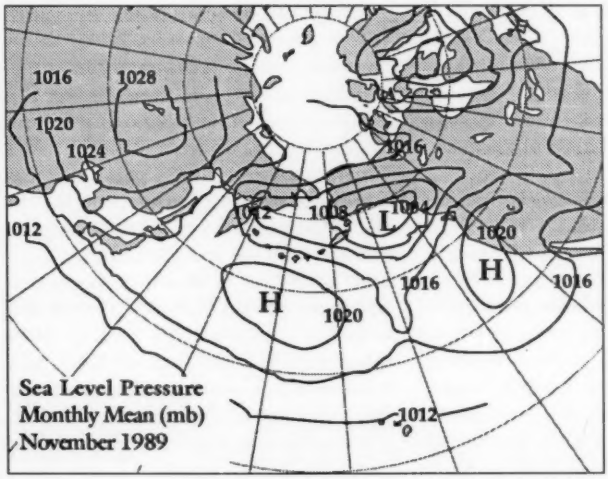


Figure 3.—Another dominant showing by the subtropical high was the feature on this month's climatic chart. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.

PA1 Dennis Schaefer

Figure 4.— On the 16th the 27 crewmen aboard the Milos Reefer abandoned ship after running aground just north of St. Matthew Is in the Bering Sea. It was reported that winds in the area were 55 kn gusting to 65 kn. They were accompanied by light snow and heavy seas. A U.S. Coast Guard Photo.

1200 very few reports were received although the storm was at its peak. A ship (56°N, 174°E) ran into 48–kn westerlies in 20–ft seas at 1200. The storm then began to fill rapidly and by 1200 on the 16th central pressure was up to 971 mb.

The weather chart on the 16th indicated a tropical depression had developed in the Philippine Sea and a 996–mb Low was crossing the 40th parallel near 155°W, moving northward. Storm No. 1 was still a factor over the northern shipping lanes. On the 17th a wave developed, along a front south of Tokyo, which was to become Storm No. 2.

❷ This wave, after coming to life on the 17th, moved east northeastward until the 19th when it headed toward the northeast. It was bucking a massive 1030–mb High, which covered a good portion of the eastern North Pacific. Southwest of the 1004–mb Low, on the 19th, Hunt reached typhoon strength. By 1200 on the 20th, the Low's central pressure was down to 992 mb but was overshadowed by another system that had formed in the Sea of Japan and was now a 978–mb Low near 50°N, 155°W. But things began to change during the next 24 hr. Storm No. 2 began to intensify. It became more intense than the sea of Japan Low by 0000 on the 21st, and 12 hr later it was at 969 mb. Early on the 21st the ***Shin–Kashu Maru*** and the ***Arnold Maersk*** both encountered 50–kn winds while the ***Louis Maersk*** (49°N, 169°W) battled 30–ft swells. The ***Sealand Anchorage*** sent in several valuable reports indicating winds in the 45–kn range and 18–ft swells, some 400 mi east of the center. At 0600 on the 22d, the ***Green Bay*** (46°N, 145°W) ran into 46–kn southerlies in 16–ft seas while the ***Golden Gate Bridge*** reported a 42–kn south southeasterly, some 600 mi east northeast of the center at 1200.

By the 23d the system began a slow turn toward the southeast and started to fill. However, it remained a trouble–maker into the 25th as it stayed over open water. Another tropical depression was developing in the western North Pacific on the 24th. By the 27th it became tropical storm Irma. To the north a 1004–mb Low was dominating the Sea of Japan and a 982–mb Low was moving toward the Gulf of Alaska. This storm, along with the remnant of Storm No. 2, was generating 45–kn winds according to the ***New Marquesa, Prince William Sound*** and the ***Neptune Pearl.*** They were also battling 15– to 25–ft swells east of the storm center. Irma was at typhoon strength by the 28th. The complex system of storm centers was creating gale force winds on the 28th between about 40° and 50°N from 130°W to 130°E. There were even one or two reports of storm force winds. Seas, in general, were running 15 to 30 ft. This situation

remained in place for the remainder of the month and was further complicated by another system.

❺ Amidst the mess that existed on the 29th, this storm developed within the circulation of the system in the Gulf of Alaska, near 50°N, 170°W. It didn't look like much at first and didn't develop its own circulation until early on the 30th. However by 1200, it was a 974–mb system and had taken over from the Gulf of Alaska center. And just because the month was ending was no signal that the storm should do the same. By 1200 on the 1st it was a potent 975–mb Low near 50°N, 150°W.

Tropical Cyclones

Summaries for both eastern and western North Pacific tropical cyclones can be found in the feature section of this issue.

Casualties

Around mid month the *Tyche* sank in strong winds and rough seas about 100 mi northwest of Naha City, Okinawa. It was reported that two of the 20–man crew died in hospital. On the 16th the ***Milos Reefer*** ran aground just north of St. Matthew Is in the Bering Sea (fig 4). A number of incidents were associated with Typhoon Gay. The ***Seng Thai Diamond*** sank between Pattani Is and Losin Is on the 2d. The ***Long Bien I*** was last seen near 7.5°N, 103.5°E on the 7th. The crew was rescued and it is believed that the vessel sank. It was also reported by Thai authorities that, overall, Gay claimed the lives of more than 500 seafarers with more than 100 fishing boats sunk. Also, the ***Seacrest***, a drilling vessel, capsized on the 15th off the resort island of Ko Samui (southwest Gulf of Siam). The vessel, with $2.3 million worth of computers onboard, was sunk to become a breeding ground for marine life.

December— A large broad Aleutian Low was deeper and more extensive than normal this month (fig 5). This resulted in negative anomalies of 4 to 6 mb over a good portion of the central North Pacific, north of about 30°N. The 998–mb system was made up of a large number of moderate systems. The upper level pattern showed a zonal flow to about 170°W with a sharp northeastward turn to the east.

On This Date

December 7, 1941— The weather report from the Monthly Aerological Record of the ***U.S.S. Enterprise***: "A large high pressure area was located NNW of Hawaii with a steep gradient which caused strong easterly surface winds. The weather was unsettled during the early morning period but conditions improved greatly after sunrise to become scattered to broken clouds at 2000 feet. Flying conditions were undesirable the entire period due to high winds."

Extratropical Cyclones

The month began with two large low pressure systems covering the North Pacific north of about 35°N and Typhoon Irma dominating the Philippine Sea. The storm approaching the Gulf of Alaska was at 965 mb at 1200 on the 1st. It had originated during the last part of November. Vessels in these waters were experiencing 45–to 50–kn winds in 13– to 20–ft seas. The ***Emerald Sea*** (48°N, 136°W) hit 52–kn south southeasterlies in 20–ft seas at 0600. The system began to weaken on the 3d. The following day a complex system, with one center over the Alaska Peninsula and the other in the Gulf of Alaska, was dominating the northeastern North Pacific. A Low over the Sea of Okhotsk was beginning to intensify about this time. These two systems while not potent were still generating some gale force winds and seas up to 16 ft along the northern shipping lanes into the 7th.

❶ Things were fairly quiet until the 9th when a 986–mb Low moving along the Kuril Is chain, began to generate gales to the southeast of its center. The ***Pavel Chebotnyagin*** (44°N, 145°E) reported 50–kn west northwest winds at 0600. At 1800 the ***Maasstad*** was nailed by 50–kn westerlies near 46°N, 153°E. Meanwhile, the NRVC, near 54°N, 164°W, was encountering another system and hit 55–kn northeasterlies and a 965–mb pressure. Actually, the situation was very complex. At 1200 on the 9th, there was a 986–mb center in the

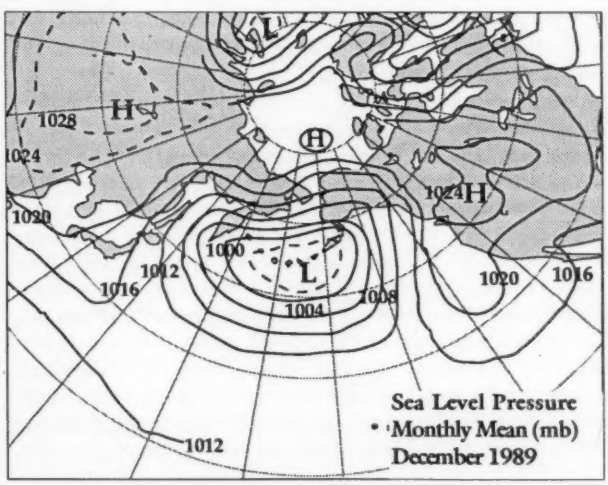


Figure 5.— The Aleutian Low dominates the North Pacific climatic chart for December. This reflects numerous moderate low pressure systems that influenced the weather over the shipping lanes. The pressure chart is based upon the chart developed by Vernon Kousky, which appears in the Climate Diagnostics Bulletin of the Climate Analysis Center of NOAA.

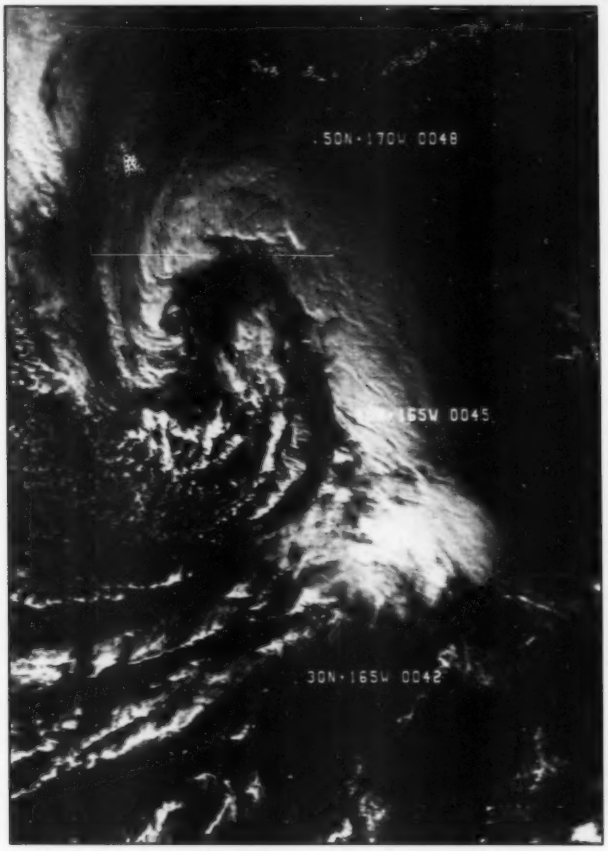


Figure 6.— Storm No. 2 is spotted by satellite on the 22d just after 0000. It was about this time that the Green Bay, some 420 mi to the southeast of the storm center, ran into 56–kn southeasterlies in 15–ft swells and recorded a 973–mb pressure. At the same time the Koyo Maru (39°N. 176°W) was blasted by a 64–kn westerly in 16–ft swells.

Kurils, another 986–mb center near 46°N, 171°E and a 970–mb center just south of the Alaska Peninsula. To simplify things, it was just a huge circulation covering most of the northern North Pacific for several days. At 0000 on the 10th, winds of 40 to 50 kn were being reported between about 40° and 48°N from 145°E to 155°E. The ***Osprey Arrow*** (46°N, 153°E) was belted by 60–kn west northwesterly winds in 20–ft swells at 0600. Several other vessels, including the ***Toyofuji No. 14*** and the UUHZ were encountering rough weather. Gale reports continued but were sporadic over the 11th and 12th.

By the 14th, at 0000, a 968–mb center was spotted near 50°N, 180°. A couple of ships reported 40–kn winds in 10–ft seas. This storm flared up just briefly as it moved northward through the Bering Sea and into the Bering St by the 16th. By this date another Low had moved eastward from Honshu and was at 971 mb by 1200, near 41°N, 164°E. This system was moving along the 40th parallel and created a few problems; however, it slowly began to fill during the next few days.

❽ On the 20th a low began to develop east of the Kuril Islands. It began as a secondary center from a previous system, but soon took over. Moving northeastward it crossed the 50th parallel near 176°E. However on the 21st, sporting a 973–mb center, it turned sharply toward the south southeast. Between 1200 on the 21st and 1200 on the 22d the central pressure dropped from 973mb to 958 mb. Ship reports were scarce on the 22d but swells of 20 to 30 ft were encountered south of the center early on the 23d. As quickly as this storm intensified it filled. By the 23d at 1200, pressure was up to 970mb as it once again headed northwestward. The following day it turned northward and continued to weaken.

Christmas day was relatively quiet on the North Pacific. A 992–mb system was crossing into eastern waters near 42°N and turning northeastward toward the Gulf of Alaska. It eventually intensified into a 982–mb storm on the 27th and managed to generate some gale force winds over the northeastern North Pacific. The month came to a close with several developing low pressure systems scattered across the Pacific and a 988–mb Low in the Gulf of Alaska, but considering it was December there was little in the way of fireworks to ring out the old decade.

Tropical Cyclones

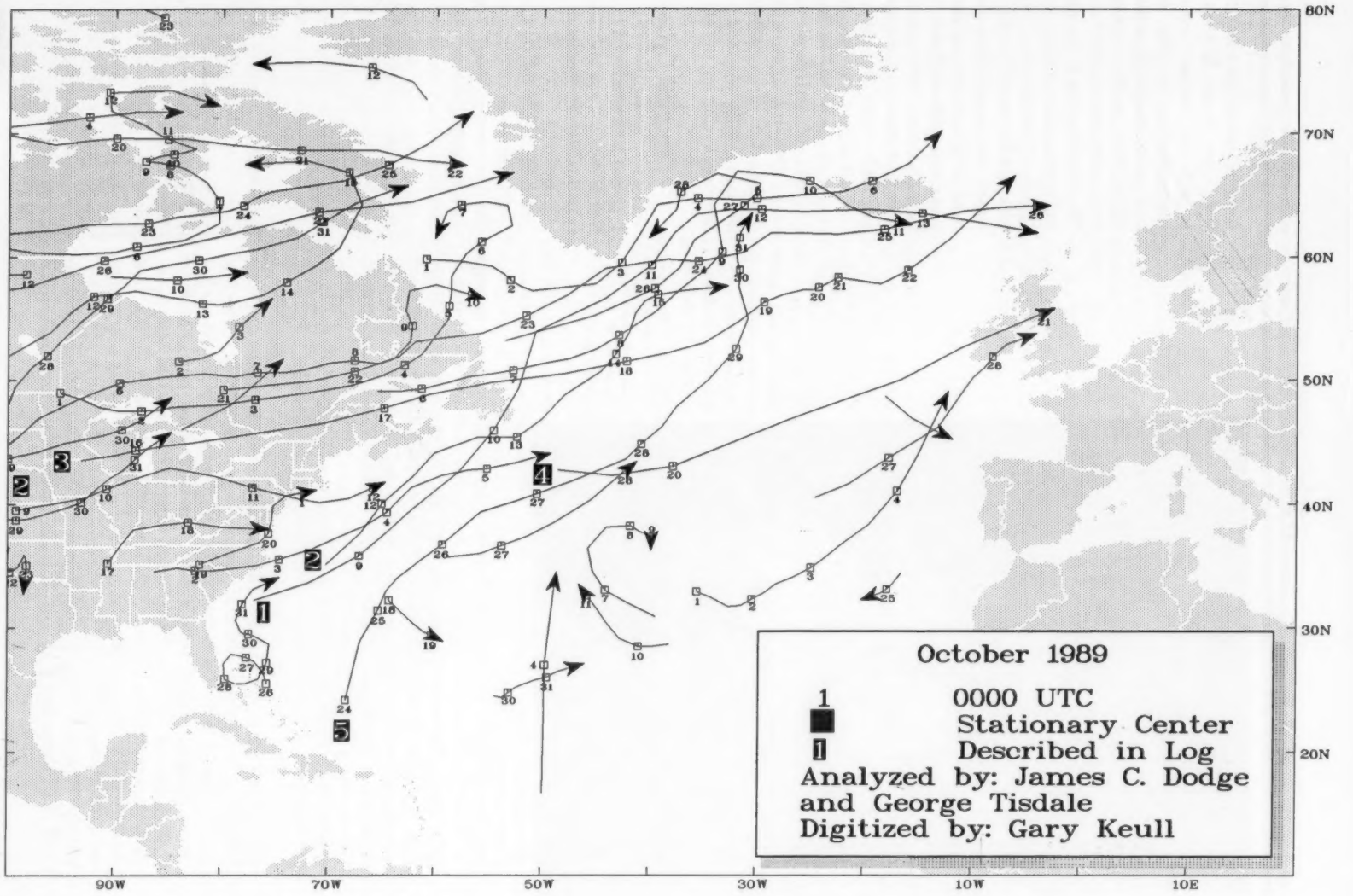
Typhoon Jack developed in the western North Pacific. See the annual summary in this issue for details.

Casualties

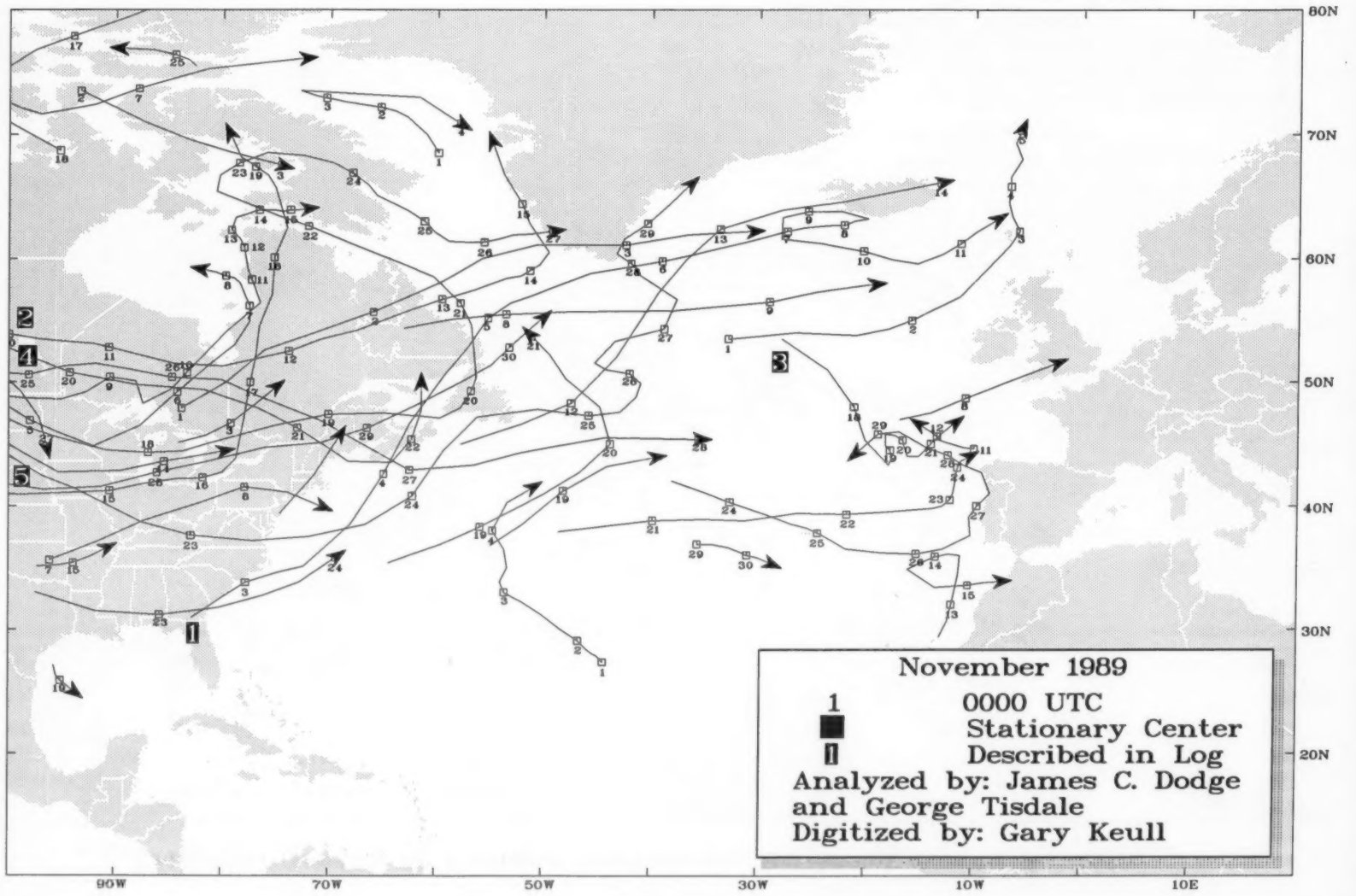
There were no reports of weather–related casualties received by this office.

Unless otherwise stated all times are Universal (UTC). All miles are nautical miles. The number next to the storm summary corresponds to the same number on the track chart. The Monster of the Month is a title given to a storm that has been particularly hazardous to shipping. The tropical cyclone summaries are based upon information provided by the National Hurricane Center, Joint Typhoon Warning Center, Central Pacific Hurricane Center and the Hong Kong Royal Observatory. Until the final report is out, these summaries should be considered preliminary.

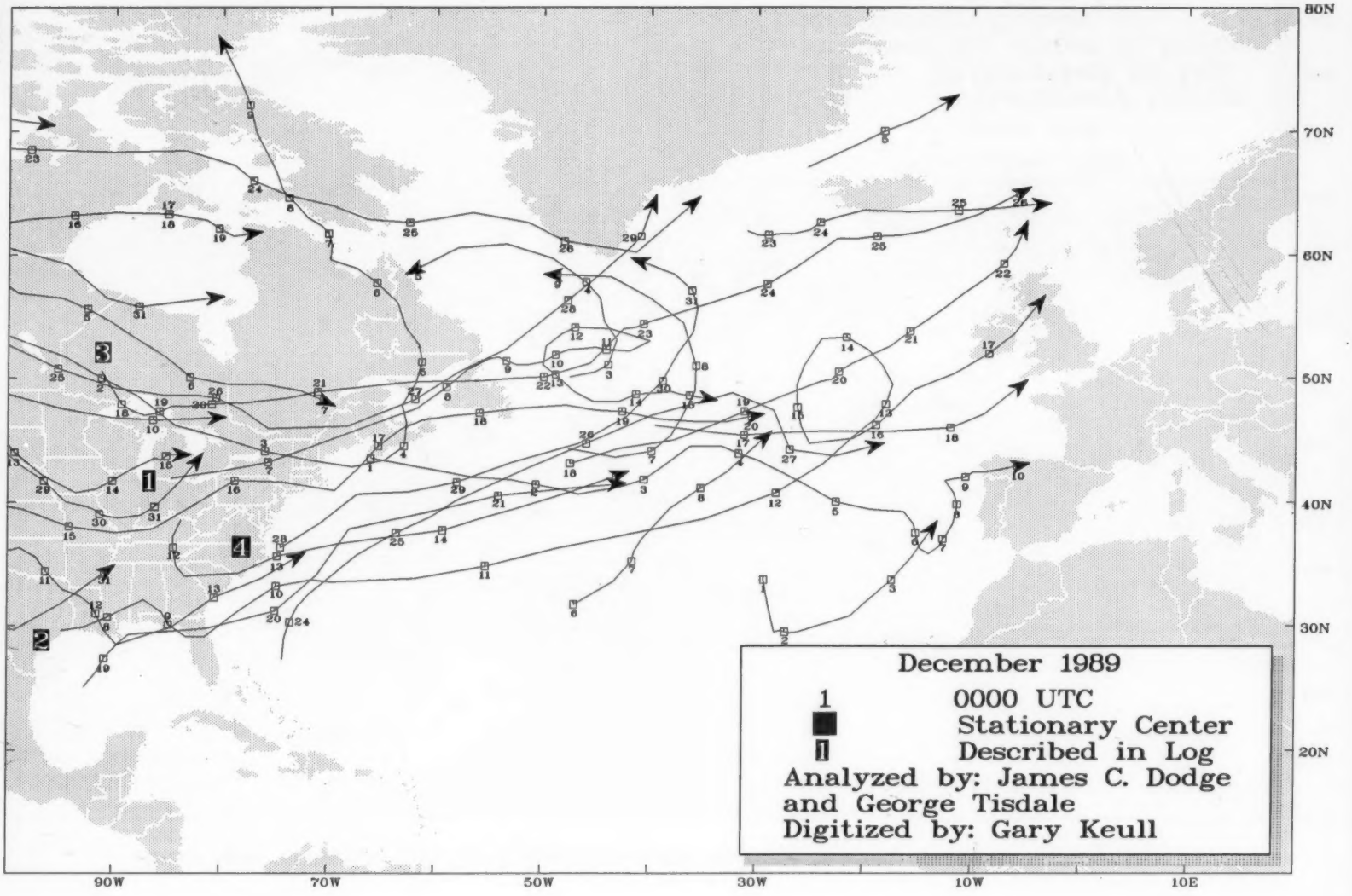
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



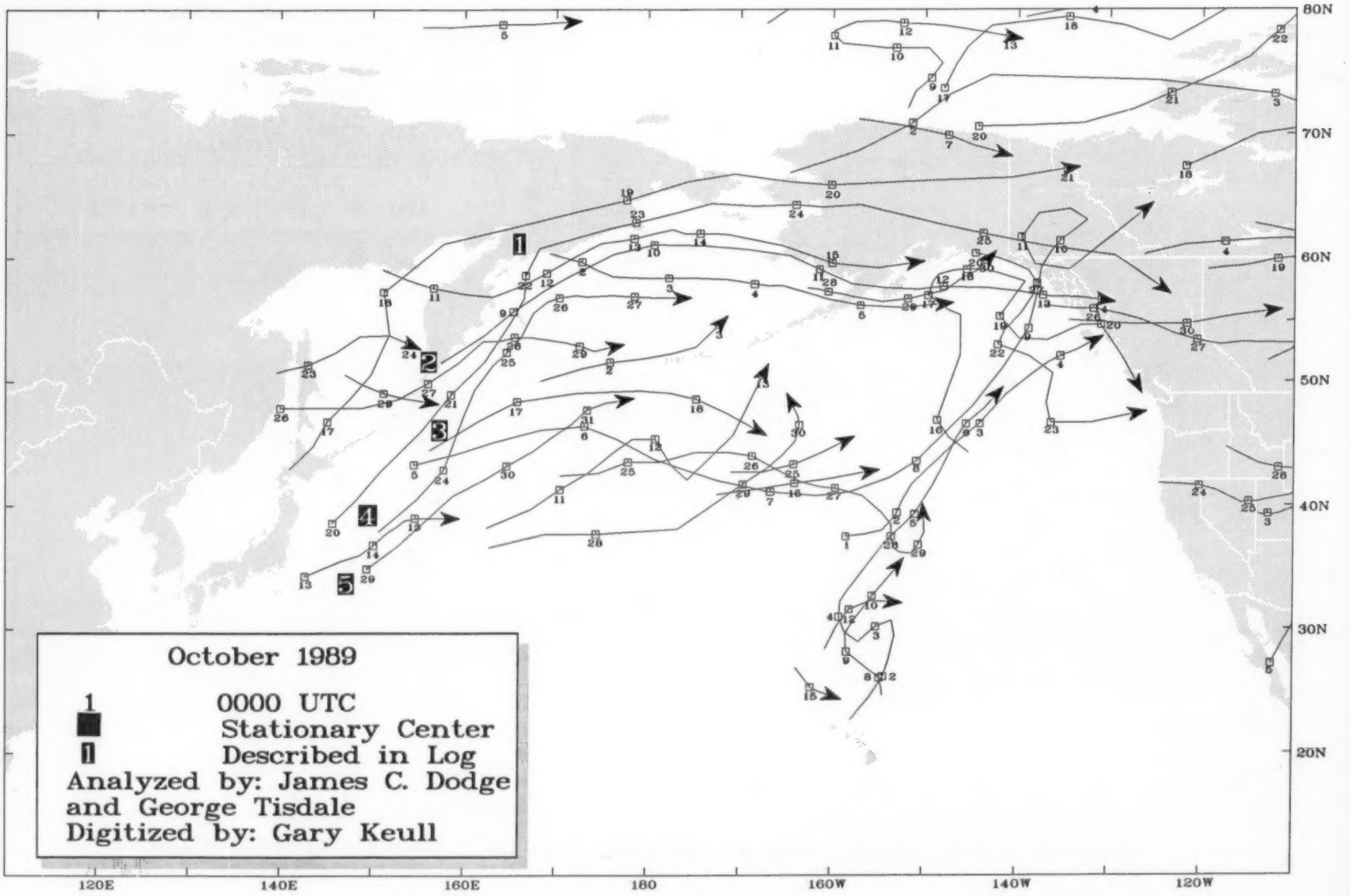
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



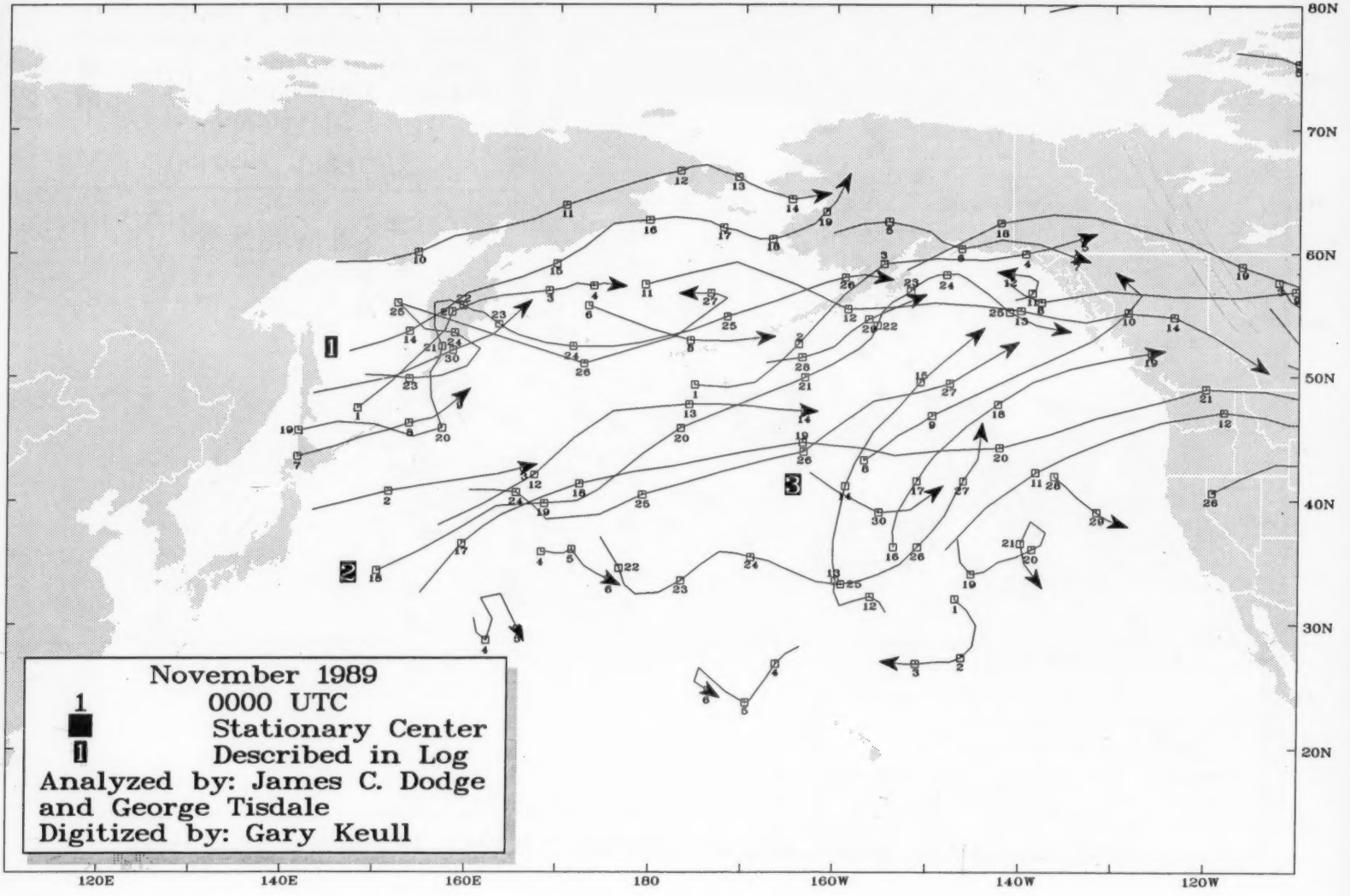
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



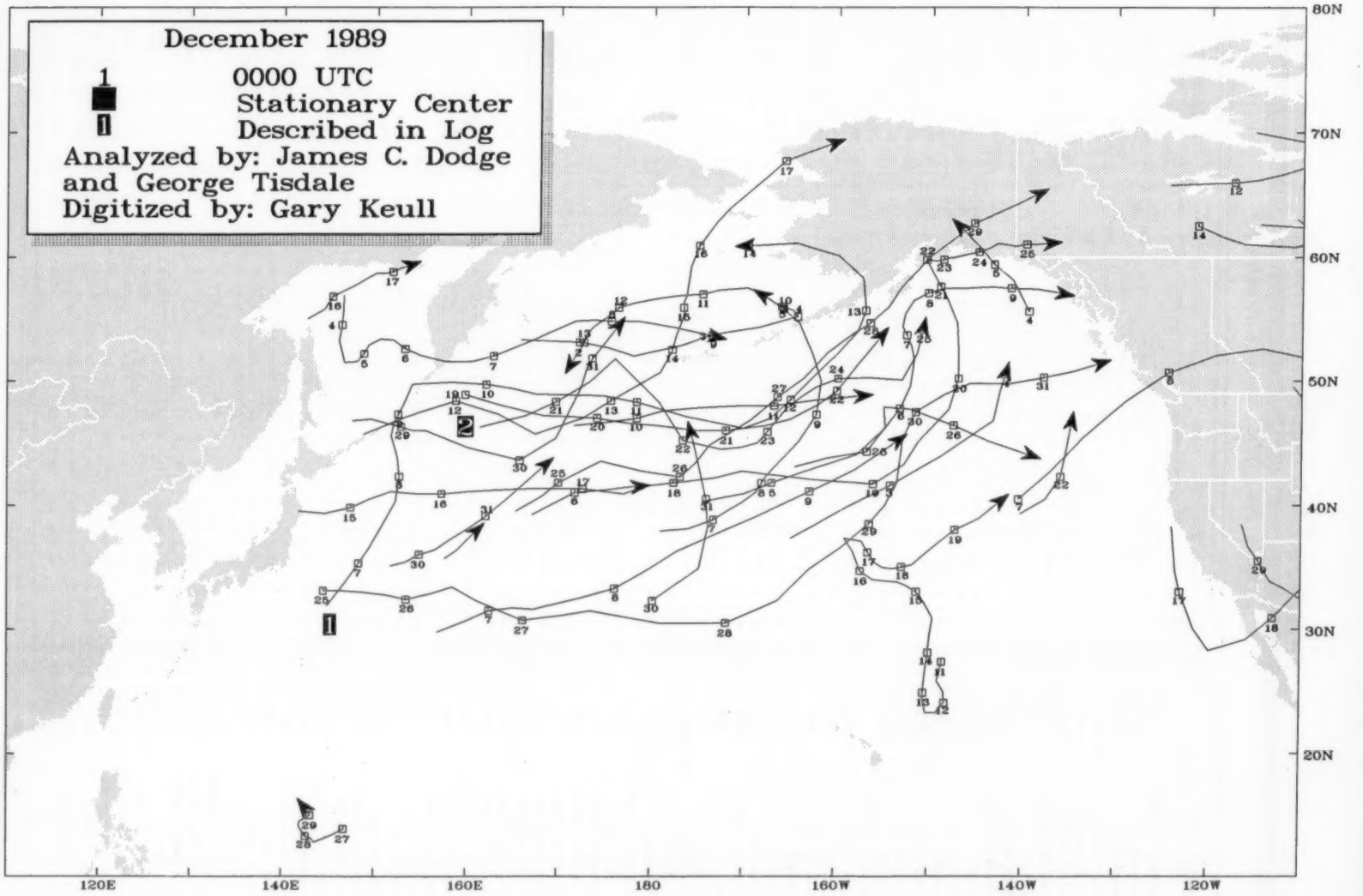
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



October, November and December 1989

VESSEL	SHIP CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.		WIND SPEED kts.		VSBY		PRES WX. code	PRESSURE mbs.	TEMP deg C. Air	TEMP deg C. Sea	SEA WAVES PD. sec	SEA WAVES HGT. ft.	SWELL WAVES DIR	SWELL WAVES PD. sec	SWELL WAVES HGT. ft.
PACIFIC OCT.																				
BACTAZAR	DUHJ	18	51.7 N	149.3 W	12	31		49		2	NM	50	1001.0	8.0	14.0	6	16.5	31	10	29.5
BACTAZAR	DUHJ	18	51.8 N	150.1 W	18	30		47		10	NM	24	1002.0	7.5	14.0	6	16.5	31	10	32.5
BRIGIT MAERSK	9VOY	20	51.6 N	148.5 W	23	31		58		1	NM	27	1000.5	7.0		13	19.5	30	18	29.5
BRIGIT MAERSK	9VOY	21	51.6 N	148.6 W	00	32		70		2	NM	16	0999.3	6.5		13	19.5	32	18	29.5
BRIGIT MAERSK	9VOY	21	51.5 N	154.2 W	18	32		54		2	NM	07	1009.2	8.0		13	19.5	32	16	31
CANADIAN RAINBOW	3EAF6	30	43.8 N	154.3 E	12	32	M	45		1	NM	80	1000.0	7.0	5.0	18	29.5	32	16	32.5
SKAUBORD	LADC2	30	41.2 N	155.9 E	12	31	M	53		1	NM	10	1004.0	9.0	14.0	11	28	31	11	29.5
SKAUBORD	LADC2	30	41.3 N	157.6 E	18	31	M	48					1005.0	10.5	13.0	11	28	01	11	29.5
ATLANTIC OCT.																				
ENSOR	ONAH	19	53.7 N	29.5 W	12	29	M	50		1	NM	81	0976.8	6.5	11.5	8	29.5			
JALISCO	XCBR	20	45.5 N	13.9 W	18	23	M	45		200	YD	46	0996.5	18.5	16.0	10	16.5	21	8	32.5
SCARAB	OVRE2	25	38.3 N	61.5 W	18	05		60		50	YD	65	1007.8	17.5	25.0	10	32.5			
NOSAC EXPRESS	LAZA2	15	53.9 N	178.7 W	06	18	M	59		.5	NM	07	0995.5	7.1	0.6	8	32.5			
PORTLAND	WNDP	21	53.3 N	166.6 W	00	04		50		2	NM		0995.0	4.0	5.8	8	42.5	04	10	32.5
PORTLAND	WNDP	21	52.4 N	170.0 W	12	04		50		.5	NM		1001.0	4.0	5.6	8	39	04	10	32.5
PACIFIC NOV.																				
NOSAC EXPRESS	LAZA2	15	53.9 N	178.7 W	06	18	M	59		.5	NM	07	0995.5	7.1	0.6	8	32.5			
PORTLAND	WNDP	21	53.3 N	166.6 W	00	04		50		2	NM		0995.0	4.0	5.8	8	42.5	04	10	32.5
PORTLAND	WNDP	21	52.4 N	170.0 W	12	04		50		.5	NM		1001.0	4.0	5.6	8	39	04	10	32.5
ATLANTIC NOV.																				
MORMACSTAR	KGDF	18	42.3 N	24.5 W	12	32		50		2	NM	81	0998.0	12.0	16.1	9	32.5	32	10	32.5
MORMACSTAR	KGDF	18	41.9 N	23.7 W	15	32		50		2	NM	25	0995.0	11.2	16.2	8	29.5	32	13	32.5
CHARLOTTE LYKES	WPHZ	19	48.0 N	27.3 W	00	36		50		5	NM	07	1003.0	11.1	15.0	15	31			
JALISCO	XCBR	19	44.2 N	27.1 W	06	35	M	50		2	NM		1000.0	12.5		6	19.5	35	8	29.5
JALISCO	XCBR	19	44.6 N	27.3 W	12	36	M	50		1	NM	25	0998.0	15.5		8	14.5	35	8	31
CHARLESTON	KNJF	21	40.2 N	70.4 W	12	29		52		10	NM	02	0985.5	6.7	12.8	20	29.5	27	25	32.5
CHARLESTON	KNJF	21	39.4 N	69.6 W	18	29		47		5	NM	02	0988.5	6.7		20	29.5	27	25	32.5
CHARLESTON	KNJF	22	38.5 N	68.9 W	00	31		50		5	NM	02	0995.0	6.7	20.0	20	29.5	31	12	32.5
PACIFIC DEC.																				
LOUIS MAERSK	CXMA2	15	35.3 N	148.6 E	18	31		49		2	NM	15	1004.0	12.0	0.0	10	29.5			
PRESIDENT KENNEDY	WRYE	15	33.7 N	152.7 E	21	30	M	54		5	NM		1001.2	15.5	21.4	7	29.5	29	10	36
PRESIDENT KENNEDY	WRYE	16	32.6 N	156.2 E	06	29	M	52		5	NM		1003.6	18.0	21.1	7	28	30	10	34.5
PRESIDENT KENNEDY	WRYE	16	32.2 N	158.6 E	12	30	M	52		5	NM		1004.3	17.0	21.5	7	28	29	10	34.5
SEALAND DEFENDER	KGJB	17	35.5 N	162.2 E	18	31	M	52		2	NM	63	1002.5	11.0	18.0	6	24.5	34	11	32.5
SEALAND DEFENDER	KGJB	18	34.9 N	167.5 E	06	29	M	60		2	NM	62	0998.0	14.0	18.0	6	24.5	29	10	34.5
SEALAND DEFENDER	KGJB	18	34.1 N	169.3 E	12	29	M	60		2	NM	18	1000.0	14.0	18.0	6	24.5	29	10	34.5
SEALAND DEFENDER	KGJB	18	33.7 N	171.9 E	18	31	M	48		2	NM	62	0999.0	16.0	20.0	6	24.5	30	10	32.5
SEALAND DEFENDER	KGJB	19	33.6 N	174.2 E	00	30	M	48		2	NM	50	1000.0	16.0	20.0	6	24.5	30	10	32.5
NATIONAL DIGNITY	DZRG	22	35.7 N	173.0 W	04	25	M	48		1	NM	82	0988.0	13.0	16.0	18	29.5	25	20	39
ATLANTIC DEC.																				
CHEVRON LONDON	ELYX	4	34.0 N	66.3 W	06	27	M	45		5	NM			20.0	22.0	6	29.5	27	6	29.5
MARIT MAERSK	OZFC2	4	45.9 N	49.6 W	12	12	M	45		1	NM		0995.1	5.2		11	32.5			
CHEVRON LONDON	ELYX	4	32.9 N	63.6 W	18	27	M	46		5	NM	82	1003.0	21.0	22.0	6	29.5	27	6	1.5
PRESIDENT TAYLOR	WJGH	11	32.4 N	39.7 W	12	20	M	45		5	NM	07	1004.0	23.0	18.3	6	24.5	23	12	31
PRESIDENT TAYLOR	WJGH	11	31.9 N	40.6 W	18	24	M	45		5	NM	07	1002.0	23.3	20.0	6	29.5			
STAR GRAN	3EWX4	12	40.5 N	25.8 W	18	25	M	45		5	NM		0998.0	16.0	20.0	8	24.5	26	8	29.5
NEDLLOYD HOLLAND	KRHX	14	52.1 N	22.7 W	00	34	M	55		1	NM		0967.5	9.4	12.0	8	29.5	33	9	29.5
AMERICAN EAGLE	WFPJ	14	37.0 N	54.5 W	15	27		50		2	NM	07	0995.0	15.6	21.0	5	8	24	10	29.5
JEBEL ALI	9KJH	14	33.1 N	38.3 W	22	23	M	52		2	NM	07	0997.5	20.0	22.0	16	23	25	18	32.5
EXPORT FREEDOM	WCJS	15	35.2 N	29.6 W	12	24		45		5	NM	02	0993.5	19.5	19.5	10	44	27	12	49
EXPORT FREEDOM	WCJS	16	35.2 N	30.4 W	03	29		48		5	NM	02	1000.5	16.7	18.4	7	32.5	27	10	39
SEALAND PERFORMANCE	KRPD	16	50.8 N	20.1 W	09	02	M	60					0995.6	9.9		15	36	02	15	36
SEALAND PERFORMANCE	KRPD	16	50.8 N	20.2 W	11	03	M	60		2	NM	60	0995.9	10.0		15	32.5	02	15	65.5
SEALAND PERFORMANCE	KRPD	18	48.1 N	41.3 W	17	06	M	57		2	NM	60		9.4		13	32.5	04	14	34.5
MSC CHIARA	IBKL	20	49.1 N	39.8 W	00	03	M	45		2	NM	25	0989.8	7.5	14.0	10	32.5			
AMERICAN VIRGINIA	WPVD	22	46.6 N	31.0 W	18	25	M	50		2	NM		1003.0	13.9	14.4	6	16.5	25	10	39
AMERICAN VIRGINIA	WPVD	23	46.1 N	33.3 W	06	22	M	45		2	NM	81	0998.0	13.9	14.7	6	19.5	22	10	32.5
AMERICAN VIRGINIA	WPVD	24	45.0 N	36.2 W	00	27	M	60		2	NM	83	0993.9	7.8	14.4	10	23	27	14	39
CHARLOTTE LYKES	WPHZ	24	45.5 N	23.9 W	06	27		50		2	NM	81	0992.1	10.6	12.0	14	29.5			
AMERICAN VIRGINIA	WPVD	24	44.3 N	37.3 W	06	29	M	55		5	NM	85	1004.0	7.0	15.2	9	19.5	29	13	36
MSC SABRINA	IBPA	28	47.5 N	35.5 W	18	26		52					1004.0	7.0	14.0	14	29.5			

October, November and December 1989

Ship Name	radio	mail
1ST LT ALEX BONNYMAN	24	20
2ND LT. JOHN P. BOBO	18	21
A. V. KASTNER	151	
ABBEY	112	
ACADIA FOREST	89	112
ACE ACCORD	78	
ACE ENTERPRISE	25	191
ACONCAGUA		2
ACT 11	43	
ACT 111	69	
ACT 12	76	
ACT 5	92	
ACT 6	93	
ACT 7	164	
ACT 9	84	
ACT I	55	
ACT IV	100	
ADABELLE LYKES	64	98
ADDIRIYAH	67	22
ADMIRALTY BAY	22	187
AFRICAN FERN	87	85
AGNES	23	57
ALAIN LD	33	
ALASKA RAINBOW	35	105
ALBERT MAERSK	12	45
ALDEN W. CLAUSEN	55	194
ALEMANIA EXPRESS	79	
ALLIGATOR FORTUNE	18	28
ALLIGATOR GLORY	31	34
ALLIGATOR HOPE	44	120
ALLIGATOR LIBERTY	82	
ALLIGATOR PRIDE	33	64
ALLIGATOR TRIUMPH	60	138
ALMERIA LYKES	53	109
ALPHA HELIX		71
ALTAMONTE	33	13
ALVA MAERSK	12	54
AMADEUS	1	
AMBASSADOR	22	39
AMBASSADOR BRIDGE	75	65
AMERICA EXPRESS	92	
AMERICA SUN	23	30
AMERICAN ALABAMA	63	105
AMERICAN CONDOR	34	62
AMERICAN CORMORANT	15	
AMERICAN EAGLE	94	166
AMERICAN FALCON	24	42
AMERICAN MAINE	60	156
AMERICAN MARINER	1	
AMERICAN REPUBLIC	66	138
AMERICAN RESOLUTE	33	138
AMERICAN UTAH	56	164
AMERICAN VIRGINIA	53	132
AMERIGO VESPUCCI	11	29
ANDERS MAERSK	73	161
ANTHONY RAINBOW	42	101
AQUA CITY	33	
AQUA GARDEN	49	57
AQUARIUS	56	187
ARCO ALASKA	19	21
ARCO ANCHORAGE	13	28
ARCO CALIFORNIA	18	14
ARCO FAIRBANKS	28	16
ARCO INDEPENDENCE	21	9
ARCO JUNEAU	27	7
ARCO PRUDHOE BAY	25	27
ARCO SAG RIVER	5	
ARCO SPIRIT	27	14
ARCO TEXAS	10	32
ARCTIC DISCOVERER	8	15
ARCTIC TOKYO	31	161
ARGONAUT	40	111
ARILD MAERSK	46	173
ARION	59	99
ARMCO	121	179
ARNOLD MAERSK	67	187
ARTHUR M. ANDERSON	176	133
ARTIC OCEAN	3	12
ASHLEY LYKES	27	
ASPEN	29	80
ASTERIKS	33	
ASTORIA	113	
ASTRO JYOJIN	1	13
ATIGUN PASS	52	257
ATLA	36	44
ATLANTIC	61	
ATLANTIC CARTIER	71	
ATLANTIC COMPANION	91	
ATLANTIC CONVEYOR	74	
ATLANTIC OCEAN	10	41
ATLANTIC SPIRIT	45	81
AURORA	2	18
AURORA ACE	95	
AUSTANGER	16	18
AUSTRAL RAINBOW	14	41
B.T. SAN DIEGO	89	186
BAAB ULLAH	11	
BACTAZAR	26	131
BADGER	17	61
BALTIMORE TRADER	19	21
BARRYDALE	100	
BAY BRIDGE	106	92
BEAUTEOUS	10	
BEBEDURO	29	44
BEER SHEVA	38	
BELGIAN SENATOR	59	
BELLE RIVER	115	253
BELLFLOWER	24	
BENSON FORD	2	
BHARATENDU	2	
BIBI	134	
BLACKHAWK		35
BLUE HAWK	50	
BOGASARI LIMA	62	119
BOHOL SAMPAGUITA	31	94
BRIGIT MAERSK	46	102
BRILLIANT ACE	115	
BROOKLYN BRIDGE	55	
BROOKS RANGE	28	39
BUNGA KENANGA	24	
BUNGA KESIDANG	6	
BUNGA MELAWIS	38	
BUNGA TEMBUSU	22	39
BURNS HARBOR	180	246
CALANUS	4	
CALCITE II	107	12
CALIFORNIA HERMES	32	11
CALIFORNIA ZEUS	25	
CANADIAN RAINBOW	37	189
CAPE BYRON	46	
CAPE HENRY	47	
CAPE HUDSON	32	28
CAPE YORK	210	
CAPRICORN	30	42
CARIBAN	95	121
CARIBE 1	7	54
CARLA A. HILLS		172
CARMEN	49	
CAROL	46	187
CAROLINA	70	158
CASON J. CALLAWAY	69	86
CATTLEYA ACE		70
CELEBRATION	62	66
CENTURY HIGHWAY #2	244	120
CENTURY HIGHWAY #5	263	117
CGM LORRAINE	69	
CHABLIS	98	166
CHACO	51	
CHARLES M. BEEGHLEY	4	
CHARLESTON	40	99
CHARLOTTE LYKES	97	144
CHELSEA	55	97
CHEMICAL PIONEER	53	74
CHERRY VALLEY	21	35
CHESAPEAKE BAY	44	104
CHESAPEAKE TRADER	24	44
CHESNUT HILL	35	57
CHEVRON ANTWERP	32	
CHEVRON ARIZONA	20	50
CHEVRON BURNABY	7	2
CHEVRON CALIFORNIA	132	168
CHEVRON COLORADO	63	85
CHEVRON COPENHAGEN		98
CHEVRON EDINBURGH	58	44
CHEVRON EQUATOR	69	183
CHEVRON FRANKFURT		41
CHEVRON LONDON		241
CHEVRON LOUISIANA	19	23
CHEVRON METEOR	53	143
CHEVRON MISSISSIPPI	66	138
CHEVRON NAGASAKI		129
CHEVRON OREGON	25	50
CHEVRON PACIFIC	55	270
CHEVRON SKY		252
CHEVRON STAR	1	153
CHEVRON SUN	9	72
CHICKASAW	21	
CHINA CONTAINER	97	164
CHRISTINA	132	
CITADEL HILL	1	
CLARENCE	74	
CLEMENT	37	
CLEMENTINA	2	
CLEVELAND	65	113
CO-OP EXPRESS II	49	
COAST RANGE	3	11
COASTAL MANATEE	10	5
COLIMA	15	22
COLUMBIA STAR	30	
COLUMBINE	3	5
COLUMBUS AMERICA	120	
COLUMBUS AUSTRALIA	98	
COLUMBUS CANADA	160	
COLUMBUS LOUISANA	240	
COLUMBUS NEW ZEALAND	144	
COLUMBUS OHIO	63	112
COLUMBUS ONTARIO	1	
COLUMBUS QUEENSLAND	87	
COLUMBUS VICTORIA	132	
COLUMBUS VIRGINIA	92	
COLUMBUS WELLINGTON	108	
CONCERT EXPRESS	57	
CONTI BAVARIA	47	
CONTINENTAL HIGHWAY	27	
CORAH ANN	70	126
CORMORANT ARROW	75	
CORNUCOPIA	49	102
CORWITH CRAMER	5	
COURTNEY BURTON	127	177
CPL. LOUIS J. HAUGE JR	39	57
CRISPEN OGLEBAY	20	38
CYPRESS PASS	8	37
D.L. BOWER		216
DAMODER GEN PARK	46	
DAVID PACKARD	15	
DELAWARE BAY	49	39
DELAWARE TRADER	98	134
DIANA	1	29
DILIGENCE TRADER	14	11
DIRECT EAGLE	102	397
DON JORGE		45
DUSSELDORF EXPRESS	61	
DYVI OCEANIC		15
EASTERN FRIENDSHIP	23	35
EASTERN GLORY	69	63
EASTERN VENTURE	41	128
EDEN	15	68
EDGAR B. SPEER	180	138
EDGAR M. QUEENY	26	22
EDWARD L. RYERSON	55	15
EDWIN H. GOTT	140	156
EL GAUCHO	3	16
ELIZABETH LYKES	26	63
ELTON HOYT II		44
EMERALD SEA	176	211
ENDEAVOR	1	
ENSOR	99	174
ERLANGEN EXPRESS	21	
ESSO PUERTO RICO	73	188
EVER BETTER	1	
EVER GALLANT	11	
EVER GATHER	1	
EVER GENIUS	6	11
EVER GENTLE	9	
EVER GIANT	3	31
EVER GIFTED	2	14
EVER GIVEN	13	
EVER GLAMOUR	26	7
EVER GLEAMY	9	
EVER GLORY	4	
EVER GLOWING	7	
EVER GOING	4	35
EVER GOLDEN	8	
EVER GOODS	13	
EVER GOVERN	1	6
EVER GRACE	6	25
EVER GRADE	7	
EVER GRAND	2	
EVER GROUP	11	
EVER GROWTH	21	15
EVER GUARD	3	4
EVER GUIDE	32	23
EVER LYRIC	23	
EXPORT FREEDOM	38	89
EXPORT PATRIOT	10	186
EXXON BATON ROUGE	13	52
EXXON BENICIA	9	17
EXXON CHARLESTON	8	
EXXON LONG BEACH	11	23
EXXON NEW ORLEANS	11	20
EXXON NORTH SLOPE	1	9
EXXON PHILADELPHIA	10	31
EXXON SAN FRANCISCO	11	11
EXXON WILMINGTON	1	
EXXON YORKTOWN	26	68
FALCON CHAMPION	1	
FALSTAFF	20	
FALSTRIA	69	22
FARLAND	2	
FARNELLA	56	
FAUST	55	29
FERNCROFT	141	177
FESTIVALE	83	109
FETISH	136	219
FLORIDA RAINBOW	53	125
FOREST SOVEREIGN	87	239
FORTALEZA	54	241
FRANCES HAMMER		106
FRANCIS SINCERE NO. 6	52	
FRED R. WHITE	22	79
FREDERICKSBURG	11	15
FREEDOM	1	
FROTASIRIUS	1	
GALVESTON BAY	73	176
GATEWAY EAST	70	136
GEMINI	101	225
GENERAL M.BELGRANDO	32	
GENEVIEVE LYKES	18	40
GEORGE A. SLOAN	152	106
GEORGE A. STINSON	54	86
GEORGE H. WEYERHAEUSER	6	9
GEORGE WASHINGTON BRID	196	
GEORGIA		87
GERMAN SENATOR	78	
GERONIMO	26	
GLACIER BAY	94	87
GLOBAL WING	63	
GLORIA ELENA	17	119
GLORIOUS SPICA	16	
GLORITA	5	
GLORY STAR	27	65
GOLDEN APO	20	
GOLDEN ENDEAVOR	26	24
GOLDEN GATE	8	12
GOLDEN GATE BRIDGE	208	65
GOLDEN HAWK	13	202
GOLDEN HILL	23	42
GRAIGLAS	108	
GREAT LAND	220	326
GREEN ANGELES	14	13
GREEN BAY	74	138
GREEN ELLIOT		27
GREEN ELLIOTT		40
GREEN HARBOUR	92	59
GREEN ISLAND	15	
GREEN KOBE	10	41
GREEN LAKE	91	125
GREEN MASTER		60
GREEN RAINIER	33	74
GREEN RIDGE	150	79
GREEN SASEBO	55	126
GREEN STAR	29	22
GREEN VALLEY	42	
GREEN WAVE	49	21
GUANAJUATO	52	74
GUAYAMA	49	91
GULF IDEAL	55	
GULF SENTRY	7	42
GUNDULIC	1	
GYPSUM BARON	160	
GYPSUM KING	164	
GYRE	7	
HAKONE MARU	136	
HANEI SKY	53	200
HANEI SUN	20	28
HANJIN BUSAN	46	31
HANJIN CHUNGMU	25	19
HANJIN HONG KONG	20	18
HANJIN KEELUNG	22	15
HANJIN KOBE	21	9
HANJIN KUNSAN	33	20
HANJIN KWANGYANG	42	19
HANJIN LONG BEACH	33	
HANJIN MOKPO	11	22
HANJIN NEW YORK	28	
HANJIN SAVANNAH	22	18
HANJIN SEATTLE	15	
HANJIN SEOUL	18	
HANJIN YOKOHAMA	15	
HANJIN YOSU	33	
HANSA CARRIER	37	
HARMAC DAWN	67	
HASSAN MERCHANT	81	134
HAWAIIAN RAINBOW	57	5
HEERENGRACHT	11	
HEIDE	156	

Ship Name	radio	mail
HENRY HUDSON BRIDGE	194	
HENRY STEINBRENNER	36	63
HERBERT C. JACKSON	1	
HERMENIA	99	74
HIRA #2	38	74
HIRA II	30	64
HOEGH CAIRN	20	11
HOEGH CLIPPER	10	20
HOEGH DYKE	3	20
HOEGH MIRANDA		13
HOHSING BREEZE	30	
HOLIDAY	66	69
HOLSTEN CARRIER	98	
HONESIA	41	90
HONOLULU	85	
HOWELL LYKES	42	84
HRELJIN	5	
HUAL ANGELITA	22	
HUAL TRANSPORTER	1	
HUDSON TRADER		97
HUMACAO	71	128
HUMBER ARM	5	80
HYUNDAI #102	11	56
HYUNDAI #108	54	
HYUNDAI CHALLENGER	30	
HYUNDAI COMMANDER	27	
HYUNDAI CONTINENTAL	42	32
HYUNDAI EXPLORER	29	26
HYUNDAI INNOVATOR	29	6
HYUNDAI ISLAND	41	
HYUNDAI NO. 109	27	8
HYUNDAI PIONEER	36	27
IBIS ARROW	16	
IMPERIAL	4	
INCOTRANS PACIFIC	69	
INFANTA	74	
INGER	64	169
IRMA M	98	
IRVING L. CLYMER	59	52
ISLA BARTOLOME	11	
ISLAND PRINCESS	169	
ITAITE	61	
ITAPE	43	
ITB PHILADELPHIA	134	129
IZOLA	1	
J. BURTON AYERS	56	74
J.L. MAUTHE	40	
JADRAN EXPRESS	18	
JALISCO	65	158
JAMES LYKES	21	23
JAPAN ALLIANCE	100	63
JAPAN APOLLO	89	64
JAPAN CARRYALL	22	
JEAN LYKES	25	
JEBEL ALI	19	45
JO BIRK	94	
JO CLIPPER	87	
JO CYPRESS	113	
JO GRAN	21	87
JO LONN	105	
JO OAK	115	
JOHANNA OLDENDORFF	1	
JOHN G. MUNSON	179	212
JOHN LYKES	26	72
JOSEPH H. FRANTZ	48	84
JOSEPH L. BLOCK	53	76
JOSEPH LYKES	32	74
JOVIAN LILY	62	176
JSS MEONIA	72	59
JUBILEE	8	
JULIUS HAMMER	50	127
KALIDAS	106	
KASINA	1	
KAUAI	73	109
KAYE E. BARKER	171	204
KEBAN		74
KEE LUNG	4	
KEISHO MARU	47	35
KENAI	61	30
KENNETH E. HILL	1	
KENNETH T. DERR	94	187
KENT	37	79
KENTUCKY HIGHWAY	27	
KEYSTONE CANYON	21	46
KEYSTONER	43	182
KIILSA		7
KISO	104	
KITTANNING	5	
KOKUA	121	61
KOLN EXPRESS	84	
KRPAN	27	
KUROBE	56	
LA PAMPA	16	
LAGO PETEN ITZA		124
LAKE CHARLES	10	
LANCASHIRE	1	
LARS MAERSK	84	60
LAURA MAERSK	34	101
LAWRENCE H. GIANELLA	49	86
LEDA MAERSK	43	94
LEISE MAERSK	38	9
LERMA	156	
LESLIE LYKES	78	145
LETITIA LYKES	39	122
LEWIS WILSON FOY	158	311
LEXA MAERSK	66	104
LIBERTY SUN	56	96
LIBERTY WAVE	46	40
LILAS		280
LING LEO	46	95
LIONS GATE BRIDGE	33	22
LIRCAY	46	
LLOYD ITAJAI	75	
LLOYD SAO PAULO	74	
LLOYD VITORIA	39	
LNG LOUISIANA	43	60
LNG TAURUS	2	149
LONG LINES	82	129
LOTUS ACE	80	
LOUIS MAERSK	47	69
LOUISE LYKES	44	28
LOUISIANA BRIMSTONE	34	51
LT. ODYSSEY	22	48
LURLINE	60	197
LUZON	39	62
LUZON SAMPAGUITA	36	29
LYRA	56	
M. P. GRACE	23	
M.T. NILE	5	

Ship Name	radio	mail
MACKINAC BRIDGE	167	57
MAERSK CONSTELLATION	70	141
MAERSK SUN	54	69
MAERSK TITAN	32	56
MAERSK TOKYO	57	
MAERSK WIND	115	200
MAGALLANES	37	45
MAGIC	77	160
MAJ STEPHEN W PLESS MP	35	32
MALINI	14	28
MALLORY LYKES	39	77
MANHATTAN BRIDGE	125	
MANUKAI	51	150
MANULANI	62	184
MARATHA MAJESTY	47	
MARCHEN MAERSK	46	96
MARGARET LYKES	75	118
MARGRETHE MAERSK	27	83
MARIA TOPIC	10	95
MARIF	26	27
MARIT MAERSK	33	115
MARITIME ASSOCIATE	73	55
MARJORIE LYKES	53	74
MARLIN		235
MARY ANNE	4	
MASON LYKES	64	76
MATHILDE MAERSK	39	79
MATSONIA	73	83
MAUI	74	200
MAWASH TAPUK	3	
MAYAGUEZ	64	127
MCKINNEY MAERSK	57	98
MEDALLION	78	
MEDUSA CHALLENGER	135	215
MELBOURNE HIGHWAY	36	59
MELGAR BAY	42	72
MERCANDIAN CONTINENT	40	28
MERCANDIAN SUN II	84	172
MERCURY ACE	52	
MERIDA	159	198
MESABI MINER	178	242
METTE MAERSK	40	138
MICHIGAN		11
MICHIGAN HIGHWAY	8	
MICRONESIAN COMMERCE	10	50
MICRONESIAN INDEPENDEN	56	40
MIDDLETOWN	107	166
MINDANAO SAMPAGUITA	21	
MINDORO SAMPAGUITA	57	27
MINERVA	14	
MING ENERGY	3	
MING GALAXY	9	
MING MOON	8	
MING OCEAN	22	20
MING PLENTY	10	
MING PROMOTION	27	38
MING PROPITIOUS	19	
MING PROSPERITY	18	
MING SPRING	18	13
MING SUN	2	
MITLA	43	
MOANA PACIFIC	207	80
MOANA WAVE		83
MOBIL ARCTIC	1	
MOBIL MERIDIAN	69	158
MOKU PAHU	71	71
MORELOS	83	92
MORMACSKY	40	87
MORMACSTAR	58	205
MORMACSUN	68	147
MOSEL EXPRESS	150	
MOSMAN STAR	1	
MSC CHIARA	21	27
MSC SABRINA	53	24
MYRON C. TAYLOR	42	3
NADA 2	42	179
NAMSAN SPIRIT	12	71
NANCY LYKES	19	
NARA	42	68
NATIONAL DIGNITY	38	132
NATIONAL HONOR	36	73
NATIONAL PRIDE	32	71
NAVIOS ENTERPRISE	16	
NAVIOS UNIQUE	161	
NECHES	1	10
NEDLLOYD ALKMAAR	121	
NEDLLOYD BAHRAIN	73	
NEDLLOYD BALTIMORE	5	
NEDLLOYD BANGKOK	87	
NEDLLOYD BARCELONA	52	
NEDLLOYD ELBE	112	
NEDLLOYD HOLLAND	67	149
NEDLLOYD HUDSON	66	122
NEDLLOYD KEMBLA	50	
NEDLLOYD KINGSTON	154	
NEDLLOYD KYOTO	139	
NEDLLOYD ROCHESTER	119	
NEDLLOYD ROTTERDAM	105	
NEDLLOYD ROUEN	69	
NEDLLOYD VAN CLOON	30	
NEPTUNE ACE	100	
NEPTUNE AMBER	89	103
NEPTUNE CORAL	62	
NEPTUNE CRYSTAL	39	66
NEPTUNE DIAMOND	43	
NEPTUNE GARNET	25	
NEPTUNE IVORY	3	
NEPTUNE JADE	50	
NEPTUNE PEARL	58	64
NEW HORIZON	129	138
NEW NOBLE		109
NEW RUBY		63
NEW TOPAZ	11	
NOAA DAVID STARR JORDA	182	86
NOAA SHIP CHAPMAN	132	151
NOAA SHIP DELAWARE II	251	383
NOAA SHIP DISCOVERER O	366	
NOAA SHIP FERREL	77	95
NOAA SHIP HECK 591	7	10
NOAA SHIP JOHN N COBB		23
NOAA SHIP M. BALDRIDGE	17	36
NOAA SHIP MCARTHUR	325	271
NOAA SHIP MILLER FREEM	165	226
NOAA SHIP MT MITCHEL	247	281
NOAA SHIP OREGON II		247
NOAA SHIP PEIRCE		24
NOAA SHIP RAINIER	116	
NOAA SHIP RUDE 590	55	75
NOAA SHIP SURVEYOR	70	
NOAA SHIP T. CROMWELL	201	185
NOAA SHIP WHITING	193	176

Ship Name	radio	mail
NOBLE STAR	100	135
NOSAC EXPRESS	72	114
NOSAC RANGER	64	105
NOSAC SKAUKAR	33	71
NOSAC SUN	9	
NOSAC TAI SHAN	18	21
NOSAC TAKAYAMA	46	
NOSAC TASCO	18	54
NOSAC TRIGGER	55	118
NUEVO SAN JUAN	78	209
NURNBERG EXPRESS	108	
OAXACA	123	
OCEAN ASPIRATION	89	90
OCEAN AUSTRALIA	72	
OCEAN BRIDGE	1	
OCEAN CHEER	1	
OCEAN COMMANDER #1	1	
OCEAN LUCKY	28	168
OCEAN SEL	19	95
OCEAN SPIRIT	37	
OCEAN STEELHEAD	23	84
OGDEN WABASH	51	82
OLEANDER	130	126
OLGA TOPIC	21	96
OLIVE ACE	95	
OMI CHAMPION	41	66
OMI MISSOURI	16	37
OMI WABASH		39
OOCL EDUCATOR	35	42
OOCL FAIR	58	48
OOCL FRIENDSHIP	51	21
ORANGE BLOSSON	75	132
ORANGE STAR	39	163
ORCHID	70	91
OREGON RAINBOW II	87	159
ORIENTAL DIPLOMAT	33	
ORIENTAL EXECUTIVE	47	28
ORIENTAL EXPLORER	71	81
ORIENTAL FAITH	35	123
ORIENTAL FORTUNE	36	25
ORIENTAL FREEDOM	98	
ORIENTAL MINISTER	6	
ORIENTAL PATRIOT	2	
ORIENTAL PINE	35	
ORION HIGHWAY	92	35
ORKANGER	40	151
OVERSEAS ALICE	19	
OVERSEAS BOSTON		124
OVERSEAS CHICAGO	8	10
OVERSEAS HARRIET	33	34
OVERSEAS JOYCE	59	77
OVERSEAS JUNEAU	3	61
OVERSEAS MARILYN	14	25
OVERSEAS NEW YORK	2	
OVERSEAS VIVIAN	9	20
OVERSEAS WASHINGTON	70	145
PAC OCEAN	11	
PAC TRADER	30	
PACBARON	14	
PACDUCHESS	36	7
PACDUKE	40	
PACGLORY	31	
PACIFIC ARROW	101	92
PACIFIC DAWN	53	59
PACIFIC PRINCESS	74	
PACIFIC SENTRY	20	
PACIFIC VENTURE	32	
PACIFIC VICTORY	29	38
PACMERCHANT	5	26
PACPRINCE	74	
PACPRINCESS	26	
PACSTAR	16	29
PATRIOT	91	209
PAUL BUCK	121	66
PAUL H. TOWNSEND	140	188
PAUL THAYER	5	
PECOS	34	19
PEGGY DON	62	
PENNSYLVANIA TRADER	48	87
PERMEKE	19	
PERSEVERANCE	55	
PETER W. ANDERSON	52	48
PETERSFIELD	1	
PFC DEWAYNE T. WILLIAM	5	
PFC EUGENE A. OBREGON	33	51
PFC JAMES ANDERSON JR	19	39
PFC WILLIAM B. BAUGH	53	48
PHAROS	85	
PHILIP R. CLARKE	150	183
PHOENIX DIAMOND	20	
PILAR	10	71
PINE FOREST	76	214
POHANG		20
POLAR ALASKA	31	170
POLYNESIA	251	292
POMEROL	54	99
POTE IBANEZ	2	
POTOMAC TRADER	42	130
PRESIDENT ADAMS	103	216
PRESIDENT ARTHUR	5	91
PRESIDENT BUCHANAN	38	172
PRESIDENT EISENHOWER	126	147
PRESIDENT F. ROOSEVELT	93	244
PRESIDENT GARFIELD	4	
PRESIDENT GRANT	68	100
PRESIDENT HARDING	68	72
PRESIDENT HARRISON	137	39
PRESIDENT HOOVER	66	162
PRESIDENT JACKSON	90	199
PRESIDENT KENNEDY	72	106
PRESIDENT LINCOLN	131	149
PRESIDENT MADISON	73	127
PRESIDENT MONROE	97	218
PRESIDENT POLK	102	174
PRESIDENT TAYLOR	18	27
PRESIDENT TRUMAN	103	128
PRESIDENT TYLER	68	159
PRESIDENT WASHINGTON	131	209
PRESQUE ISLE	140	226
PRINCE OF TOKYO	59	111
PRINCE OF TOYKO II	107	219
PRINCE WILLIAM SOUND	21	58
PRINCESS DIAN		147
PUERTO CORTES	104	114
PUNTA BRAVA	12	
PURITAN	60	
PVT HARRY FISHER	38	75
QUEEN ELIZABETH 2	60	
RAINBOW BRIDGE	98	54
RAINBOW HOPE	101	150

Ship Name	radio	mail
RALEIGH BAY	67	181
RANA M	8	
RANGER	61	34
RANI PADMINI	19	35
RESERVE	35	57
RHINE FOREST	63	158
RICHARD G MATTIESEN	56	75
RICHARD REISS	7	
RIJEKA EXPRESS	37	
RIMBA KERUING		16
RIO ESQUEL	59	31
RIO FRIO	105	
RIO GRANDE	3	
RIO LIMAY	16	
RIO NEGRO II	27	26
RIVER ETERNITY	8	
ROBERT E. LEE	14	
ROGER BLOUGH	26	34
ROGER R. SIMONS	3	
ROSETTA	49	188
ROSINA TOPIC	8	47
ROSTAND	1	
ROTTERDAM	87	
ROVER	91	289
ROYAL PRINCESS	95	
ROYAL VIKING SKY	5	
RUTH LYKES	41	95
S.T. CRAPO	155	217
SAM HOUSTON	18	39
SAMRAT ASHOK	25	
SAMU	22	
SAMUEL COBB	25	32
SAN MARTIN I	68	
SAN MATEO VICTORY	28	110
SAN MIGUEL BAY	25	
SANKO HAWK	25	
SANKO MARQUESA	1	
SANKO PRELUDE	47	83
SANSINENA II	85	126
SANTA ADELA	80	59
SANTA JUANA	66	
SANTA VICTORIA	13	
SATURN DIAMOND	27	58
SAUDI ABHA	7	
SAUDI DIRIYAH	47	
SAUDI HOFUF	10	
SAUDI MAKKAH	15	
SAUDI TABUK	19	
SAVANNAH	93	
SAVANNAH MARU	1	
SCARAB	12	98
SEA BELLS	18	9
SEA COMMERCE	15	
SEA DIAMOND	118	54
SEA FAM	81	164
SEA FORTUNE	31	226
SEA FOX	32	53
SEA JADE	11	36
SEA LANTERN	23	166
SEA LIGHT	38	156
SEA LION	178	149
SEA MERCHANT	1	
SEA TRADE	69	
SEA WEALTH	9	
SEA WOLF	186	200
SEALAND ANCHORAGE	35	117
SEALAND ATLANTIC	56	84
SEALAND CHALLENGER	61	82
SEALAND COMMITMENT	109	56
SEALAND CRUSADER	117	99
SEALAND DEFENDER	55	158
SEALAND DEVELOPER	70	64
SEALAND DISCOVERY	28	53
SEALAND ENDURANCE	35	
SEALAND ENTERPRISE	174	269
SEALAND EXPEDITION	8	28
SEALAND EXPLORER	65	171
SEALAND EXPRESS	62	142
SEALAND FREEDOM	57	135
SEALAND HAWAII	93	238
SEALAND INDEPENDENCE	55	128
SEALAND INNOVATOR	61	79
SEALAND KODIAK	29	86
SEALAND LIBERATOR	64	118
SEALAND MARINER	84	162
SEALAND NAVIGATOR	72	235
SEALAND PACIFIC	83	242
SEALAND PATRIOT	77	160
SEALAND PERFORMANCE	67	144
SEALAND PRODUCER	43	82
SEALAND QUALITY	55	135
SEALAND TACOMA	44	61
SEALAND TRADER	114	213
SEALAND VOYAGER	110	152
SEAWARD BAY	29	
SEDCO/BP 471	43	
SENATOR	79	78
SEVEN OCEAN	33	
SGT WILLIAM A BUTTON	21	8
SGT. METEJ KOCAK	19	25
SHELDON LYKES	99	149
SHELLY BAY	77	61
SHENAHON	16	20
SHIN BEISHU MARU	42	
SHINKASHU MARU	67	
SHIRAOI MARU	91	29
SIERRA MADRE	8	
SILVER CLIPPER	35	
SINGA ACE	1	
SINGAPORE VICTORY	4	36
SIOUX TATE	20	
SKANDERBORG	9	
SKAUBORD	78	136
SKAUGRAN	88	104
SKEENA	48	
SOARER BELLONA		52
SOARER CUPID	23	107
SOLAR	4	
SOLAR WING	89	209
SONBAI	61	
SONORA	66	189
SOPHIA	51	
SOREN TOUBRO	14	
SOUTHLAND STAR	141	
SPIRIT OF TEXAS	31	100
SPRING BEAR	174	
SPRING BEE	35	
SPRING SWIFT	20	
SPRING VEGA	12	68
ST EMILION	4	
STAR DOVER	49	
STAR EAGLE	44	75
STAR ESPERANZA	5	
STAR EVVIVA	32	
STAR FLORIDA	73	
STAR FUJI	4	
STAR GEIRANGER	11	20
STAR GRAN	41	140
STAR GRINDANGER	2	7
STAR HONG KONG	46	
STAR MINDAWAN	9	
STAR MINERVA	17	63
STAR RANGER	13	64
STEWART J. CORT	149	185
STONEWALL JACKSON	25	
STRATHCONON	131	
STRIDER ISIS	124	201
STUTTGART EXPRESS	72	
SUE LYKES	25	70
SUGAR ISLANDER	46	
SUNBELT DIXIE	134	174
SUNNY SUPERIOR	1	
SUNWARD II	137	
SUSAK	12	
SWAN LAKE	25	48
TABASCO	82	157
TAI CHUNG	24	21
TAI CORN	23	30
TALISMAN	22	25
TAMPA	18	
TAMPA BAY	3	
TARGET	80	149
TAYABAS BAY	82	74
TEMSE	8	180
TEXACO MINNESOTA	53	
TEXACO NEW YORK	9	2
TEXACO VERACRUZ	294	118
TEXACO WESTCHESTER	121	122
TFL ENTERPRISE	2	
THOMAS WASHINGTON	150	223
THOMPSON LYKES	6	24
THOMPSON PASS		63
TOBA	13	
TOHZAN	2	14
TOKYO MARU	63	
TOLUCA	46	83
TONCI TOPIC	2	
TONSINA	95	145
TOWER BRIDGE	58	
TRITON	103	194
TRONDANGER	5	
TROPIC SUN	42	57
TROPICALE	119	144
TRUDY	161	
TULSIDAS	60	
TUNISIAN REEFER	61	51
TUVA	18	
TYSON LYKES	45	59
ULTRAMAR	39	48
ULTRASEA	30	76
UNAMONTE	34	31
UNI-SPRING	45	141
UNI-SUMMIT	38	
UNI-SUPERB	3	23
UNITED HOPE	48	84
UNIVERSE	17	
URTE	57	111
USCGC ACACIA (WLB406)	10	
USCGC ACTIVE WMEC 618	6	
USCGC ALERT (WMEC 630)	2	13
USCGC BASSWOOD (WLB 38	41	
USCGC BISCAYNE BAY	5	
USCGC BUTTONWOOD WLB 3	3	
USCGC CHEROKEE WMEC 16	50	
USCGC CITRUS (WMEC 380	139	
USCGC CLOVER (WMEC 292	17	
USCGC CONIFIR(WLB 301)	1	
USCGC COURAGEOUS	1	
USCGC DAUNTLESS WMEC 6		3
USCGC DEPENDABLE	38	
USCGC EAGLE (WIX 327)	13	
USCGC ESCANABA	134	
USCGC EVERGREEN WMEC 2	10	
USCGC FIREBUSH WLB 393	9	
USCGC FORWARD	5	5
USCGC HAMILTON WHEC 71	7	
USCGC HARRIET LANE	16	
USCGC IRONWOOD (WLB 29	107	117
USCGC JARVIS (WHEC 725	24	
USCGC KATMAI BAY	1	2
USCGC MALLOW (WLB 396)	4	
USCGC MESQUITE (WLB 30	4	
USCGC MIDGETT (WHEC 72	6	
USCGC MOBIL BAY	1	
USCGC MORGENTHAU	1	
USCGC NEAH BAY	5	
USCGC NORTHLAND WMEC 9	67	44
USCGC PLANETREE	9	24
USCGC POLAR STAR WAGB	202	156
USCGC RELIANCE WMEC 61	16	59
USCGC RESOLUTE WMEC 62	34	
USCGC SASSAFRAS	17	
USCGC SEDGE (WLB 402)	13	
USCGC SPENCER	82	
USCGC STORIS (WMEC 38)	105	124
USCGC SUNDEW (WLB 404)	1	
USCGC SWEETBRIER WLB 4	11	
USCGC TAHOMA	19	
USCGC TAMAROA (WMEC 16	17	
USCGC TAMPA WMEC 902		55
USCGC THETIS	2	
USCGC VALIANT (WMEC 62	4	6
USCGC VIGOROUS WMEC 62	1	
USCGC YOCONA (WMEC 168	51	32
USNS ALGOL	3	
USNS ALTAIR	34	
USNS AUDACIOUS		62
USNS BARTLETT(T-AGOR 1	26	
USNS CAPABLE		74
USNS CATAWABA	17	
USNS CHAUVENET TAGS 29	16	
USNS DE STEIGUER		127
USNS DENEBOLA	5	
USNS GUS W. DARNELL	97	45
USNS HARKNESS (T-AGS 3	9	
USNS JOSHUA HUMPREYS	51	16
USNS KANE TAGS 27		24
USNS LEROY GRUMMAN		69
USNS LYNCH T-AGOR 7	92	
USNS MAUMEE	68	
USNS MAURY	4	11
USNS MERCURY	80	185
USNS MERCY		21
USNS MOHAWK (T-ATF 170	30	
USNS NARRAGANSETT	3	
USNS NAVAJO	51	68
USNS PASSUMPSIC TAO 10		103
USNS PAWCATUCK TAO-108		205
USNS POLLUX	13	
USNS POWHATAN TATF 166	21	
USNS RANGE SENTINEL	18	
USNS REDSTONE	4	
USNS REGULUS	8	
USNS SEALIFT ANTARCTIC	30	76
USNS SEALIFT ARABIAN S	24	
USNS SEALIFT ARCTIC	55	82
USNS SEALIFT ATLANTIC	1	
USNS SEALIFT CARIBBEAN	76	161
USNS SEALIFT CHINA SEA	29	40
USNS SEALIFT IND'N OCE	34	
USNS SEALIFT MED	12	17
USNS SEALIFT PACIFIC	5	32
USNS SIRIUS (T-AFS 8)		28
USNS SPICA (T-AFS 9)		26
USNS VANGUARD TAG 194	44	27
USNS WILKES T-AGS-33	32	
VALLEY FORGE	52	168
VIRGO	24	72
VISHVA PALLAV	5	
VISHVA PANKAJ	8	
VISHVA PAROG	13	
VISHVA PRAFULLA	26	
VISHVA SIDDHI	1	
WALCHAND	3	
WASHINGTON HIGHWAY	165	
WASHINGTON RAINBOW 82	25	101
WESTWARD VENTURE	51	8
WESTWOOD ANETTE	72	54
WESTWOOD BELINDA	17	32
WESTWOOD CLEO	136	106
WESTWOOD JAGO	121	109
WESTWOOD MARIANNE	27	148
WESTWOOD MERCHANT		85
WESTWOOD MERIT	34	
WESTWOOD MUSKETEER	11	
WHITE ROSE	47	71
WILFRED SYKES	94	139
WILLIAM E. MUSSMAN	12	
WILLIAM J. DELANCEY	303	326
WILLIAM R. ROESCH	67	107
WINDWARD SENTRY	51	81
WINTER MOON	10	
WINTER WATER	138	
WINTER WAVE	1	
WOLVERINE	42	58
WORLD WING 82	31	27
YACU WAYO	9	11
YAMATAKA MARU	65	
YANKEE CLIPPER	80	
YOUNG SCOPE	89	
YOUNG SKIPPER	48	
YOUNG SOLDIER	24	
YOUNG SPROUT	96	41
YS ARGOSY	24	
ZEELANDIA	94	
ZEUS	1	
ZIM GENOVA	29	
ZIM HAIFA	28	
ZIM HONGKONG	22	
ZIM HOUSTON	33	
ZIM IBERIA	66	
ZIM KEELUNG	65	
ZIM LIVORNO	1	
ZIM MARSEILLES	12	
ZIM MIAMI	19	
ZIM NEW YORK	28	
ZIM SAVANNAH	49	
ZIM TOKYO	53	

Summary of U.S. VOS Weather Reports

Grand Total Via Radio— 53,775
Grand Total Via Mail— 60,209
Total Duplicates— 25,214 (23.4%)

Unique Radio Obs.— 28,561 (32.2%)
Unique Mail Obs.— 34,995 (33.4%)
Total Unique Obs.— 88,770

Top Ships

Radio
William J. Delancey
NOAA Discoverer

Mail
William J. Delancey
NOAA Delaware II

October, November and December 1989

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
A3BE	58	58	0	COLUMBUS CANADA
A3B2	33	33	0	ACT 12
A8VI	20	20	0	PACDUCHESS
BNTB	32	32	0	R.V.14
CBVM	7	7	0	VINA DEL MAR
CGBS	6	6	0	PARIZEAU
CGDV	265	265	0	W. TEMPLEMAN
CG2676	43	43	0	***
CG2680	59	59	0	***
C7C	171	0	171	OCEAN STATION CHARLIE
C7L	121	121	0	OCEAN STATION LIMA
DAKE	84	84	0	KOELN ATLANTIC
DA9100	140	140	0	***
DBLK	30	30	0	POLAR STERN
DGLM	12	12	0	MONTE ROSA
DGVK	76	76	0	COLUMBUS VICTORIA
DGZV	63	63	0	COLUMBUS VIRGINIA
DGZU	1	1	0	***
DHCW	7	7	0	COLUMBUS WELLINGTON
DHJW	198	198	0	ACT 9
DHOU	11	11	0	PURITAN
DLE3	28	28	0	YANKEE CLIPPER
DSCW	2	2	0	***
D5NE	27	27	0	MT CABRITE
D5N3	97	97	0	POLYNESIA
ELED7	30	30	0	PACPRINCE
ELED8	13	13	0	PACPRINCESS
ELHL6	14	14	0	***
EREA	149	113	36	MUSSON
EREB	120	21	99	VOLNA
EREC	113	4	109	PRILIV
EREI	134	3	131	OKEAN
ERES	158	123	35	VICTOR BUGAEN
ERET	36	35	1	GEORGE OUSHAKOV
EREU	72	70	2	ERNST KRENKEL
FAUB	2	2	0	ENSEIGNE DE VAISSEAU
FNCZ	54	54	0	LIBREVILLE
FNGB	40	40	0	MARION DUFRESNE
FNGS	113	113	0	LA FAYETTE
FNOM	29	29	0	ANGO
FNPA	96	96	0	RONSARD
FNQB	87	87	0	ILE MAURICE
FNQC	89	89	0	VILLE DE ROUEN
FNQM	51	51	0	VILLE DE MARSEILLE
FNZO	24	24	0	RABELAIS
FNZP	76	76	0	RACINE
FNZQ	103	103	0	RIMBAUD
FPID	7	7	0	ROSPICO
FPYO	9	9	0	CAP SAINT PAUL
FZVN	216	216	0	SUROIT
GACA	5	5	0	***
GOVL	22	22	0	ACT 4
GOVN	43	43	0	ACT 6
GPHH	37	37	0	FARNELLA
GQEK	81	81	0	FORTHBANK
GTIA	33	33	0	***
GYRW	28	28	0	ENCOUNTER BAY
GYSA	49	49	0	FLINDERS BAY
GYSE	34	34	0	NEDLLOYD TASMAN
GZKA	25	25	0	ACT 3
HO4667	18	18	0	***
HPEW	108	108	0	PACIFIC ISLANDER
H8CB	113	113	0	***
H9BQ	34	34	0	MICRONESIAN INDEPENDENCE
INCO	3	3	0	***
JBOA	63	63	0	KEIFU MARU
JBRR	47	47	0	JAPAN TUNA II
JCCX	150	150	0	CHOFU MARU
JCDT	33	33	0	AMERICA MARU
JCIN	36	36	0	TOKYO MARU
JCOD	70	70	0	SHOYO
JDRD	38	38	0	SHOYO MARU
JDWX	140	140	0	RYOFU MARU
JFDG	121	121	0	SHUMPU MARU
JGZK	202	202	0	RYOFU MARU
JJTV	74	74	0	***
JJ3C	2	2	0	HAKONE MARU
JLTI	5	5	0	SATSUNAN
JM5DF	46	46	0	***
JPJX	64	64	0	HAKURYU MARU
JPVB	69	69	0	SEIFU MARU
JQNY	101	101	0	ZUIRYU MARU
JSVY	10	10	0	SHIRASE
KGSM	20	20	0	***
KGWU	31	31	0	TH. WASHINGTON
KIRH	4	4	0	SEALAND TRADER
KNBD	36	36	0	DELAWARE II
KRGB	59	59	0	SEALAND ENTERPRISE
LFA	42	42	0	***
NAEE	2	2	0	DE STEIGUER
NAVOCE	2	2	0	U.S. NAVAL OCEANOGRAPHIC
NAWR	3	3	0	***
NBMO	21	21	0	MISSOURI
NBTM	36	36	0	POLAR STAR
NDKB	1	1	0	***
NEKF	8	8	0	LYNCH
NENC	6	6	0	SEALIFT PACIFIC
NFKQ	5	5	0	SEALIFT ARABIAN SEA
NGDF	5	5	0	MUNRO
NHNC	2	2	0	H. LANE
NIKL	2	2	0	TAMPA

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
NLGF	14	14	0	NORTHLAND
NNRJ	1	1	0	HULL
NQST	13	13	0	SEALIFT ARCTIC
NSBR	13	13	0	***
NSHE	2	2	0	***
NYGG	20	20	0	CHAUVENET
OWEQ2	21	21	0	MCKINNEY MAERSK
OWUO6	74	74	0	MOANA PACIFIC
OXMD2	16	16	0	LARS MAERSK
PGDG	47	47	0	NEDLLOYD KINGSTON
PGDS	17	17	0	NEDLLOYD KYOTO
PGDT	26	26	0	NEDLLOYD BALTIMORE
PGDV	32	32	0	NEDLLOYD BANGKOK
PGEH	6	6	0	NEDLLOYD BAHREIN
PGEM	23	23	0	NEDLLOYD BARCELONA
PJYG	59	59	0	OLEANDER
SEPI	5	0	5	***
SHIP	640	640	0	***
S6FK	43	43	0	SWAN REEFER
UBN2	92	86	6	SHULEYKIN AKADEMIK
UEAK	78	2	76	VALERIAN URYVAYEV
UFYN	8	0	8	KAPITAN SHAYTANOV
UINF	202	195	7	***
UJFO	98	85	13	MULTANOVSKIY PROF
UMAY	56	1	55	AKADEMIK SHIRSHOV
UMFW	87	87	0	PROF. ZUBOV
UQHM	66	2	64	ABAKANLES
UQYC	25	2	23	AKADEMIK FEDOROV
UUPB	164	19	145	AKADEMIK N. SHOKALSKIY
UUQR	5	5	0	MOLCHANOV PAVEL PRO
UVMJ	4	4	0	VSEVOLOD BERYOZKIN
UVMM	125	109	16	GAKKEL, YAKOV
UWEC	14	1	13	PROFESSOR KHROMOV
UWFH	1	1	0	***
UZCB	48	35	13	***
UZGH	9	8	1	PASSAT
VCTF	9	9	0	CAPE BRIER
VC9450	70	70	0	GADUS ATLANTICA
VJBQ	18	18	0	ANRO AUSTRALIA
VKCK	14	14	0	STUART
VKCN	32	32	0	CANBERRA
VKCV	18	18	0	DERWENT
VKDA	13	13	0	DARWIN
VKLA	10	10	0	ADELAIDE
VKLC	15	15	0	BRISBANE
VKMK	80	80	0	SWAN
VKML	13	13	0	SYDNEY
VKMN	15	15	0	PARRAMATTA
VKMS	183	183	0	COOK
VKPT	39	39	0	PERTH
VLNB	89	89	0	TORRENS
VMAP	70	70	0	AUSTRALIAN PROGRESS
VP19	75	75	0	AIRCRAFT SQUADRON
VXN8	65	65	0	AIRCRAFT
WAF3311	22	22	0	***
WCGN	2	2	0	CHEVRON CALIFORNIA
WDAG	10	10	0	SHENEHON
WRA4560	26	26	0	BOLD VENTURE
WRBA	1	1	0	***
WRBB	6	6	0	***
WRBU	4	4	0	***
WSE3385	26	26	0	GLORITA
WTDF	52	52	0	T. CROMWELL
WTDK	201	201	0	D.S. JORDAN
WTDM	10	10	0	M. FREEMAN
WTEA	147	147	0	DISCOVERER
WTEF	2	2	0	RAINIER
WTEG	4	4	0	MOUNT MITCHELL
WTEJ	179	179	0	MCARTHUR
WTER	2	2	0	M. BALDRIDGE
WTES	51	51	0	SURVEYOR
WTEW	20	20	0	WHITING
WTEZ	6	6	0	FERREL
WXBR	44	44	0	CHEVRON MISSISSIPPI
WXQ7334	7	7	0	PETER ANDERSON
WYR4481	3	3	0	W.J. DELANCY
WZE39	13	13	0	MOANA WAVE
2CSK	28	28	0	SKEENA
2CSL	42	42	0	NIMOS
3BBA	5	5	0	MAURITIUS
3EAB7	8	8	0	CALIFORNIA ZEUS
3EET4	72	72	0	SEAS EIFFEL
3EZG5	11	11	0	HIKAWA II
7JDU	5	5	0	NATSUSHIMA
7JOB	12	12	0	SHINKASHU MARU
7KDD	28	28	0	YOKO MARU

TOTAL BATHYS RECEIVED 8617
TOTAL TESACS RECEUVED 1029
TOTAL REPORTS RECEIVED 9646

October, November and December 1989

Wave observations are taken each hour during a 20–minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one–third of the waves during the hourly averaging period. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0–minute averaging period each hour (moored buoys) and a 2.0–minute averaging period for fixed stations (C–MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688–2838 for more details.

		LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	OCTOBER 1989													
BUOY	32302	18.0S	085.1W	0669	17.2	18.1	2.2	3.9	09/05	14.1	SE	22.3	02/14	1018.3
	41001	34.9N	072.0W	0742	22.6	25.1	1.9	4.8	25/18	13.7	NE	25.5	31/09	1018.8
	41002	32.2N	075.3W	0744	23.6	25.6	1.9	5.4	29/16	14.6	E	27.2	29/07	1016.8
	41008	30.7N	081.1W	0447	24.8	25.7	1.0	2.5	09/16	11.3	NE	23.1	09/14	1016.2
	41009	28.5N	080.2W	1476	25.0	27.3	1.5	5.4	28/06	12.7	NE	33.2	29/03	1017.3
	41010	28.9N	078.5W	1480	25.1	27.3	1.8	5.8	28/05	11.3	NE	30.7	10/14	1016.8
	41011	28.2N	080.1W	0401	26.9	27.9	1.1	3.4	10/07	10.7	NE	25.8	10/08	1015.9
	42001	25.9N	089.7W	0743	25.1	27.8	1.1	3.2	19/16	10.4	E	29.9	19/07	1014.8
	42002	26.0N	093.5W	0742	25.0	27.0	1.2	4.7	15/00	12.0	E	53.2	15/01	1016.9
	42003	25.9N	085.9W	0737		27.3	1.0	3.4	20/00	10.9	NE	23.9	19/12	1016.8
	42007	30.1N	088.8W	0738	20.9	23.4	0.6	1.4	14/00	11.3	NE	27.8	19/13	1019.8
	42015	30.2N	088.2W	0737	20.7	23.1	0.5	1.3	13/21	9.4	NE	22.5	19/23	1019.3
	42016	30.2N	088.1W	0700	20.7	22.9	0.5	1.3	13/22	9.3	NE	22.2	09/11	1018.5
	44004	38.5N	070.6W	0198	18.9	20.5	2.3	4.8	26/13	10.8	NE	28.6	31/20	1024.6
	44005	42.7N	068.6W	0398	12.5	13.1	1.5	4.2	19/18	12.4	NW	28.2	05/14	1016.1
	44007	43.5N	070.1W	0735	10.4	10.6	0.9	3.1	20/14	10.7	SW	27.2	04/01	1018.0
	44008	40.5N	069.5W	0737	14.3	14.8	1.6	4.2	19/21	13.0	W	36.7	04/01	1018.8
	44009	38.5N	074.6W	0742	16.4	17.3	1.1	4.0	19/09	11.8	NW	33.8	19/07	1019.4
	44011	41.1N	066.6W	0247	13.4	13.4	1.8	4.0	20/00	9.6	W	22.0	12/00	1018.7
	44013	42.4N	070.8W	0739	12.0	12.0	0.7	4.0	19/17	12.0	SW	32.1	19/16	1018.6
	45001	48.0N	087.7W	0741	5.7	5.9	0.9	3.1	02/14	11.9	SE	28.2	02/15	1015.8
	45002	45.3N	086.4W	0744	8.6	9.8	1.0	3.8	12/00	14.3	S	30.1	11/22	1016.6
	45003	45.3N	082.7W	0740	7.4	7.6	0.9	3.1	04/03	13.3	S	28.2	02/20	1016.6
	45004	47.5N	086.5W	0738	5.8	5.8	1.0	3.9	02/18	13.0	S	30.1	02/14	1016.6
	45005	41.7N	082.4W	0353	13.2	15.4	0.5	1.5	07/04					1015.6
	45006	47.3N	089.9W	0743	6.4	6.1	0.7	2.0	02/12	10.0	SW	22.5	31/06	1016.2
	45007	42.7N	087.1W	0741	11.4	12.9	1.1	3.9	20/02	13.4	S	27.0	19/22	1018.4
	45008	44.3N	082.4W	0733	10.1	11.7	1.0	3.3	19/21	14.1	S	27.2	19/19	1017.0
	46001	56.3N	148.3W	0739	8.6	10.7	3.2	8.4	17/20	16.3	NW	31.8	17/16	1004.6
	46002	42.5N	130.4W	0742	15.7	17.2	2.3	6.0	22/06	11.3	SW	24.3	21/23	1020.1
	46003	51.9N	155.9W	0740	8.6	9.4	3.3	7.2	11/22	19.7	NW	39.2	21/04	1011.3
	46005	46.1N	131.0W	0741	14.4	15.8	2.5	5.2	22/19	11.0	NW	23.4	24/17	1018.4
	46006	40.8N	137.7W	0741	16.3	17.3	2.5	6.4	22/03	13.4	SW	31.3	21/16	1020.4
	46010	46.2N	124.2W	0742	12.0	12.2	1.9	4.7	22/16	11.1	S	35.4	22/11	1018.3
	46011	34.9N	120.9W	0383	14.6	15.1	1.6	2.8	02/19	10.2	NW	21.2	16/22	1016.2
	46012	37.4N	122.7W	0743	13.9	14.6	1.6	4.1	23/14	10.0	NW	29.4	23/13	1018.2
	46013	38.2N	123.3W	0743	12.6	13.1	1.8	4.8	23/16	11.1	NW	29.4	23/10	1016.8
	46014	39.2N	124.0W	0742	12.2	12.4	2.0	4.7	23/14	11.0	NW	38.2	23/08	1017.2
	46022	40.8N	124.5W	0739	11.7	11.6	2.0	4.7	23/09	8.8	N	32.0	23/09	1018.2
	46023	34.3N	120.7W	0744	15.6	15.6	1.7	3.1	25/18	12.4	NW	25.4	15/22	1016.4
	46025	33.7N	119.1W	0431	17.1	17.9	1.0	3.1	26/01	6.3	NW	24.5	25/17	1017.4
	46026	37.8N	122.7W	0743	13.3	13.8	1.3	3.8	23/15	9.9	NW	36.1	23/12	1017.2
	46027	41.8N	124.4W	0717	11.0	11.1	1.9	4.7	23/11	9.3	W	30.9	23/09	
	46028	35.8N	121.9W	0740	14.7	14.9	1.9	4.0	24/15	9.6	NW	24.2	14/10	1017.3
	46030	40.4N	124.5W	0740	11.5	10.8	1.9	5.0	23/07	13.2	N	40.8	23/06	1017.4
	46035	57.0N	177.7W	0741	5.8	6.8	3.6	12.9	10/03	21.4	W	44.1	10/00	1005.4
	46040	44.8N	124.3W	0739	11.7	12.1	2.0	5.6	22/14	9.4	N	32.3	22/10	1019.0
	46041	47.4N	124.5W	0739	11.6	12.5	1.8	4.2	22/22	9.1	SE	27.2	23/15	1018.1
	46042	36.8N	122.4W	0740	14.2	15.5	1.8	4.1	23/17	10.7	NW	27.4	23/12	1018.3
	51001	23.4N	162.3W	0744	25.6	27.0	2.1	4.2	10/08	8.7	E	22.3	23/10	1014.3
	51002	17.2N	157.8W	0740	26.3	27.1	1.9	3.2	02/04	11.9	E	19.8	16/00	1013.4
	51003	19.2N	160.8W	0740	26.5	27.8	1.8	3.1	11/03	8.6	E	19.6	24/16	1012.9
	51004	17.5N	152.6W	0037	25.7	26.3	2.2	3.0	01/06	14.2	E	22.2	01/06	1013.9
C–MAN	ALSN6	40.5N	073.8W	0736	14.5	15.1				13.0	NW	39.1	19/13	1018.5
	BURL1	28.9N	089.4W	0741	21.6					10.9	NE	31.3	13/04	1017.7
	BUZM3	41.4N	071.0W	0743	13.5					14.6	SW	36.4	19/15	1018.5
	CARO3	43.3N	124.4W	0738	11.4					6.4	N	24.5	26/09	1019.2
	CBLV2	36.9N	075.7W	0739	17.8	19.3	1.8	2.6	19/03	12.6	NE	29.0	20/12	1020.2
	CLKN7	34.6N	076.5W	0735	19.4					10.9	NE	25.5	08/14	1019.5
	CSBF1	29.7N	085.4W	0742	21.1					5.9	NE	23.3	01/12	1018.8
	DBLN6	42.5N	079.4W	0602	12.5					10.5	S	33.6	19/06	1019.9
	DESW1	47.7N	124.5W	0743	11.4					10.7	SE	38.7	26/05	1018.0
	DISW3	47.1N	090.7W	0740	7.7					11.2	SW	29.3	02/09	1017.7
	DPIA1	30.3N	088.1W	0739	20.0	21.7				9.7	NE	26.6	19/23	1019.9
	DSLN7	35.2N	075.3W	0604	20.4	23.3	1.5	3.4	26/20	16.2	NE	35.7	02/20	1019.4
	FARP2	8.6N	144.6E	0695	28.2					6.7	NW	25.7	01/17	1009.1
	FBIS1	32.7N	079.9W	0712	19.9					9.9	NE	31.3	27/11	1019.1
	FPIA2	57.3N	133.6W	0741	7.3					12.8	SE	42.8	07/02	1011.1
	FPSN7	33.5N	077.6W	0739	21.9					15.7	W	31.5	28/23	1018.8
	GBCL1	27.8N	093.1W	0738	23.7	27.2				14.0	E	35.1	15/03	1018.0
	GDIL1	29.3N	090.0W	0733	21.6	22.9				9.7	NE	29.2	19/11	1018.6
	GLLN6	43.9N	076.4W	0740	10.7					14.1	S	34.6	03/19	1018.3
	IOSN3	43.0N	070.6W	0742	11.2					13.6	W	35.0	04/00	1018.9
	LKNF1	26.6N	080.0W	0740	24.8	27.5				7.7	NW	24.0	28/01	1015.9
	MDRM1	44.0N	068.1W	0742	9.9					15.3	W	35.1	19/11	1017.9
	MISM1	43.8N	068.9W	0743	10.1					15.2	W	34.1	04/02	1018.0
	MLRF1	25.0N	080.4W	0744	25.8	28.4				10.4	N	30.7	20/15	1016.2
	MPCL1	29.4N	088.6W	0735	22.2					11.6	NE	34.2	19/15	1018.3
	NWPO3	44.6N	124.1W	0737	10.6					6.1	E	27.0	23/22	1019.1
	PILM4	48.2N	088.4W	0741	6.3					12.4	N	36.9	02/10	1017.2
	PTAC1	39.0N	123.7W	0739	11.7					8.2	N	36.1	23/09	1017.8
	PTAT2	27.8N	097.1W	0546	22.9	24.0				13.0	SE	25.1	31/06	1018.1
	PTGC1	34.6N	120.7W	0738	15.2					11.6	N	29.6	25/23	1017.2
	ROAM4	47.9N	089.3W	0729	6.1					14.3	SW	41.3	02/09	1016.4
	SAUF1	29.9N	081.3W	0728	22.9	24.8				12.9	NE	33.7	29/17	1018.2
	SBIO1	41.6N	082.8W	0742	12.3					11.9	S	38.0	22/05	1018.6

		LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	SGNW3	43.8N	087.7W	0742	9.2					12.3	S	33.6	19/19	1017.5
	SISW1	48.3N	122.8W	0744	10.4					7.6	SE	36.1	26/07	1018.8
	SMKF1	24.6N	081.1W	0317	28.3	29.1				9.1	SE	27.8	10/03	1016.2
	SPGF1	26.7N	079.0W	0739	26.0	28.3				5.9	NE	27.4	20/14	1016.3
	SRST2	29.7N	094.1W	0738	21.2					10.1	SE	31.0	16/04	1019.4
	STDM4	47.2N	087.2W	0743	7.3					17.2	S	39.1	21/03	1016.6
	SVLS1	32.0N	080.7W	0744	20.7	22.8				14.7	NE	30.2	29/20	1018.4
	TPLM2	38.9N	076.4W	0743	15.6	17.2				9.3	NW	26.6	19/04	1019.8
	TTIW1	48.4N	124.7W	0739	10.7					11.0	NE	34.1	11/15	1018.2
	VENF1	27.1N	082.5W	0740	23.2	26.4				7.5	NE	25.8	20/18	1016.7
	WPOW1	47.7N	122.4W	0700	11.6					7.3	S	35.2	21/21	1018.4
	NOVEMBER		1999											
BUOY	32302	18.0S	085.1W	0694	17.7	18.2	1.8	2.9	30/16	11.7	SE	19.8	02/13	1016.9
	41001	34.9N	073.0W	0718	19.5	23.1	2.3	6.8	21/07	14.6	W	31.5	23/14	1017.3
	41002	32.2N	075.3W	0714	21.3	24.1	1.7	4.9	23/14	12.1	W	30.9	23/13	1017.2
	41008	30.7N	081.1W	0140	20.8	21.0	0.6	1.4	09/15	7.1	S	18.1	09/12	1016.0
	41009	28.5N	080.2W	1161	22.9	25.0	1.1	2.1	17/08	10.7	N	23.7	23/14	1018.8
	41010	28.9N	078.5W	1435	23.0	25.2	1.3	3.0	21/13	12.3	N	27.8	23/14	1018.8
	42001	25.9N	089.7W	0715	23.8	25.8	1.2	3.8	30/23	12.5	E	29.0	29/21	1016.6
	42002	26.0N	093.5W	0718	23.7	25.4	1.4	5.0	19/23	12.7	S	33.6	18/20	1016.7
	42003	25.9N	085.9W	0716	24.0	26.0	1.1	3.6	16/21	12.1	E	26.8	30/01	1017.5
	42007	30.1N	088.8W	0720	17.5	20.2	0.5	1.4	16/05	12.0	N	32.8	16/04	1019.5
	42015	30.2N	088.2W	0717	17.4	19.8	0.6	1.6	08/17	10.2	NE	28.6	16/05	1019.1
	42016	30.2N	088.1W	0329	19.8	20.8	0.5	1.5	08/18	8.6	SE	19.8	09/14	1017.4
	44004	38.5N	070.6W	0707	14.6	19.4	2.3	8.3	21/15	17.3	NW	42.4	21/13	1014.9
	44005	42.7N	068.6W	0237	7.7	9.8	2.0	4.0	01/09	17.6	NW	51.1	21/18	1011.3
	44007	43.5N	070.1W	0707	4.8	8.9	1.0	4.1	17/00	14.9	SW	40.8	21/16	1011.5
	44008	40.5N	069.5W	0713	9.7	11.9	2.3	6.7	21/14	17.7	W	41.2	21/08	1014.1
	44009	38.5N	074.6W	0711	10.8	13.8	1.2	3.6	16/17	11.3	N	21.6	01/13	1016.4
	44011	41.1N	066.6W	0237	10.0	11.7	2.8	9.5	22/00	13.9	NW	35.0	23/18	1013.5
	44013	42.4N	070.8W	0719	6.6	9.5	0.6	2.4	23/19	16.5	SW	43.7	21/17	1012.7
	45001	48.0N	087.7W	0717	-1.7	4.4	1.5	4.3	29/19	16.0	NW	31.3	11/14	1009.9
	45002	45.3N	086.4W	0502	2.6	7.0	1.3	4.1	16/17	17.1	NW	35.2	16/15	1009.3
	45003	45.3N	082.7W	0717	1.1	5.6	1.5	5.0	20/22	17.4	NW	39.2	20/22	1009.8
	45004	47.5N	086.5W	0719	-0.8	4.6	1.7	5.1	20/19	17.1	NW	35.0	20/15	1010.3
	45006	47.3N	089.9W	0717	-0.9	4.5	1.1	3.8	29/20	14.7	W	31.7	20/18	1011.0
	45007	42.7N	087.1W	0347	6.5	8.8	1.1	3.3	04/12	14.2	S	28.2	04/13	1012.2
	45008	44.3N	082.4W	0672	3.0	7.6	1.5	5.2	21/01	17.6	W	37.9	21/01	1010.2
	46001	56.3N	148.3W	0720	4.2	6.7	3.5	8.1	21/23	15.3	W	31.3	06/19	1000.9
	46002	42.5N	130.4W	0716	14.1	15.4	2.6	6.5	26/15	11.4	W	25.1	26/06	1022.1
	46003	51.9N	155.9W	0716	5.4	7.1	3.9	9.3	21/15	18.8	W	37.1	20/23	1004.9
	46005	46.1N	131.0W	0718	12.6	13.6	3.1	7.4	14/02	13.8	SW	27.3	28/06	1019.4
	46006	40.8N	137.7W	0714	15.0	15.4	2.7	7.3	25/20	14.3	S	35.6	27/19	1021.4
	46010	46.2N	124.2W	0716	10.3	11.2	2.2	6.9	14/07	12.8	S	33.8	23/12	1019.7
	46012	37.4N	122.7W	0719	13.4	13.5	1.7	3.8	27/06	10.1	NW	24.4	25/21	1019.5
	46013	38.2N	123.3W	0719	12.2	12.4	1.9	3.8	05/03	10.6	NW	27.0	07/03	1018.5
	46014	39.2N	124.0W	0720	12.0	12.3	2.2	5.1	04/10	10.6	NW	33.1	25/18	1019.1
	46022	40.8N	124.5W	0718	11.0	10.9	2.2	5.0	14/15	7.5	N	21.8	14/12	1020.7
	46023	34.3N	120.7W	0715	15.5	15.5	1.9	4.1	27/06	11.5	NW	27.4	27/07	1016.8
	46025	33.7N	119.1W	0719	17.2	17.7	0.9	1.7	26/17	5.8	NW	20.2	28/16	1016.9
	46026	37.8N	122.7W	0718	13.0	13.0	1.4	3.1	27/03	9.5	NW	28.2	25/21	1018.8
	46027	41.8N	124.4W	0700	10.4	10.4	2.0	4.6	27/01	8.9	N	23.5	06/02	
	46028	35.8N	121.9W	0718	14.4	14.7	2.0	4.4	27/13	9.6	NW	23.5	08/02	1018.0
	46030	40.4N	124.5W	0719	10.9	10.5	1.9	4.5	26/20	11.2	N	21.0	04/07	1019.8
	46035	57.0N	177.7W	0718	1.1	4.7	3.6	10.8	16/06	19.3	W	42.6	15/04	1007.3
	46040	44.8N	124.3W	0719	10.9	11.6	2.3	6.1	14/13	9.6	S	29.3	23/12	1020.9
	46041	47.4N	124.5W	0717	9.7	10.7	2.4	6.5	14/08	10.6	SE	26.6	23/11	1019.0
	46042	36.8N	122.4W	0720	13.4	13.9	2.0	4.8	27/09	10.1	N	25.6	26/09	1019.5
	51001	23.4N	162.3W	0719	24.1	25.6	2.7	6.2	16/22	12.9	E	24.5	15/18	1015.2
	51002	17.2N	157.8W	0717	25.9	26.9	2.3	4.9	17/13	12.6	E	24.5	22/20	1013.7
	51003	19.2N	160.8W	0720	25.6	26.8	2.4	5.5	17/04	11.5	E	22.8	22/15	1013.4
	51004	17.5N	152.6W	0502	25.3	26.1	2.1	4.1	17/18	11.4	E	22.1	22/12	1013.6
C-MAN	ALSN6	40.5N	073.8W	0708	8.2	11.9				17.7	NW	51.1	21/11	1014.3
	BURL1	28.9N	089.4W	0717	19.1					13.8	NE	31.9	23/01	1017.5
	BUZM3	41.4N	071.0W	0713	8.0					19.6	W	44.1	21/09	1013.3
	CARO3	43.3N	124.4W	0720	10.5					7.7	S	30.5	23/15	1021.2
	CHLV2	36.9N	075.7W	0713	12.7	15.4	1.0	3.2	23/13	15.0	SW	38.5	21/12	1017.8
	CLKN7	34.6N	076.5W	0716	15.5					11.1	SW	28.3	21/03	1018.2
	CSBF1	29.7N	085.4W	0718	17.3					5.4	NE	16.8	16/07	1019.3
	DBLN6	42.5N	079.4W	0715	5.5					16.8	SW	50.4	20/23	1012.9
	DESW1	47.7N	124.5W	0718	9.4					12.1	SE	33.1	23/12	1018.8
	DISW3	47.1N	090.7W	0710	-1.1					15.2	W	41.5	20/14	1012.8
	DPIA1	30.3N	088.1W	0717	16.8	18.4				11.1	N	29.7	16/04	1019.7
	DSLN7	35.2N	075.3W	0697	16.8	21.1	1.5	3.7	16/10	17.9	W	44.4	23/03	1017.6
	EMIP2	11.4N	162.4E	0503	27.9					10.4	E	21.4	12/04	1007.1
	FARP2	8.6N	144.6E	0607	28.0					6.8	NE	31.8	27/06	1008.3
	FBIS1	32.7N	079.9W	0713	15.9					7.5	W	25.5	23/06	1018.5
	FFIA2	57.3N	133.6W	0718	3.6					15.5	SE	37.1	27/19	1006.6
	FPSN7	33.5N	077.6W	0712	18.3					14.5	SW	42.7	23/09	1018.3
	GBCL1	27.8N	093.1W	0717	21.7	25.3				15.8	S	41.5	16/01	1017.8
	GDIL1	29.3N	090.0W	0718	18.7	19.6				10.7	NE	32.5	16/04	1018.4
	GLLN6	43.9N	076.4W	0711	4.4					18.8	W	44.7	17/05	1011.8
	IOSN3	43.0N	070.6W	0713	5.5					18.3	W	45.1	21/10	1012.4
	LKWF1	26.6N	080.0W	0715	23.8	25.5				9.4	E	23.0	30/03	1017.4
	MDRM1	44.0N	068.1W	0716	4.9					19.9	NW	55.1	21/16	1011.0
	MISM1	43.8N	068.9W	0713	5.0					20.3	W	55.1	21/15	1011.4
	MLRF1	25.0N	080.4W	0718	25.0	26.4				12.3	E	24.7	17/11	1017.2
	MPCL1	29.4N	088.6W	0671	19.6	22.7				9.3	SE	31.7	16/03	1018.2
	NWPO3	44.6N	124.1W	0720	9.7					7.7	E	27.0	12/14	1021.0
	PILM4	48.2N	088.4W	0718	-2.8					16.1	NW	43.7	20/13	1011.7
	PTAC1	39.0N	123.7W	0717	11.0					6.6	N	31.8	25/17	1019.7
	PTAT2	27.8N	097.1W	0708	19.5	21.1				11.9	N	28.3	18/23	1016.9
	PTGC1	34.6N	120.7W	0718	15.2					9.9	N	30.7	26/16	1017.8
	ROAM4	47.9N	089.3W	0660	-1.9					18.3	N	46.9	20/16	1010.7
	SAUF1	29.9N	081.3W	0682	19.0	21.0				8.2	N	23.3	30/12	1019.2
	SBIO1	41.6N	082.8W	0713	4.5					17.5	SW	44.4	21/04	1013.7
	SGNW3	43.8N	087.7W	0716	1.2					13.1	NW	32.3	04/09	1012.8
	SISW1	48.3N	122.8W	0717	9.2					9.2	SE	38.1	23/13	1019.3
	SPGF1	26.7N	079.0W	0712	24.1	26.3				8.7	E	21.0	30/06	1018.1
	SRST2	29.7N	094.1W	0719	16.7					9.8	S	22.4	18/04	1018.9
	STDM4	47.2N	087.2W	0714	-0.9					19.5	N	47.1	20/18	1010.5

		LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	SVLS1	32.0N	080.7W	0717	16.9	18.9				11.4	N	37.0	16/13	1018.4
	TPLM2	38.9N	076.4W	0666	9.1	11.6				13.4	S	39.2	21/17	1015.9
	TTIW1	48.4N	124.7W	0718	8.7					15.0	E	42.1	09/23	1018.6
	UJAP2	8.9N	165.7E	0599	27.5					6.6	E	21.9	21/05	1006.8
	VENF1	27.1N	082.5W	0718	20.2	22.2				7.2	NE	27.1	16/17	1017.9
	WPOW1	47.7N	122.4W	0687	9.1					10.7	S	31.0	09/23	1019.1
	DECEMBER		**1989**											
BUOY	32302	18.0S	085.1W	0726	19.5	19.8	1.9	3.1	26/16	10.0	SE	17.7	02/12	1017.3
	41001	34.9N	073.0W	0376	15.5	21.5				17.4	NW	41.3	10/06	1012.9
	41002	32.2N	075.3W	0103	16.0	23.8	2.2	5.2	04/06	17.3	NW	31.3	04/04	1016.2
	41008	30.7N	081.1W	0726	10.6	14.6	1.0	2.8	23/15	11.9	N	27.0	23/17	1019.3
	41009	28.5N	080.2W	0940	16.3	21.4	1.4	4.9	25/13	12.3	NW	33.8	23/18	1019.8
	41010	28.9N	078.5W	1479	19.3	23.6	1.9	6.3	24/16	13.9	W	35.4	09/23	1018.7
	42001	25.9N	089.7W	0741	19.1	22.7	1.4	4.5	23/00	12.6	NE	33.8	22/23	1019.2
	42002	26.0N	093.5W	0739	19.0	23.3	1.7	4.8	23/00	14.3	NE	32.3	12/14	1019.6
	42003	25.9N	085.9W	0739	20.5	25.9	1.4	4.4	09/18	13.5	NE	30.7	23/23	1019.2
	42007	30.1N	088.8W	0738	9.0	14.4	0.5	1.4	19/04	14.2	N	29.3	23/02	1021.6
	42015	30.2N	088.2W	0739	9.1	14.0	0.6	1.6	19/08	12.0	N	26.0	23/14	1021.0
	44004	38.5N	070.6W	0734	6.0	15.2	2.6	7.4	04/07	18.5	NW	36.3	04/02	1015.1
	44005	42.7N	068.6W	0058	-0.6	7.6				21.4	NW	39.5	07/15	
	44007	43.5N	070.1W	0695	-6.5	5.3	0.6	3.5	03/07	13.5	N	29.1	03/22	1014.2
	44008	40.5N	069.5W	0739	0.1	6.2	2.0	5.2	16/20	18.5	NW	38.7	17/06	1014.8
	44009	38.5N	074.6W	0732	1.0	7.8	1.3	3.5	24/20	17.2	NW	38.7	16/07	1018.6
	44011	41.1N	066.6W	0422	1.0	7.4	2.7	6.7	17/03	17.2	W	34.0	27/08	1014.3
	44013	42.4N	070.8W	0738	-5.0	5.0	0.5	2.8	16/11	17.2	NW	34.8	07/11	1015.5
	45001	48.0N	087.7W	0023	-4.4	3.6	0.6	1.0	01/11	11.1	NE	17.3	01/21	1020.0
	45003	45.3N	082.7W	0270	-5.1	4.7	1.3	4.1	02/10	15.8	W	29.5	02/10	1014.8
	45004	47.5N	086.5W	0072	-5.5	3.9	1.8	4.4	02/22	17.7	N	32.1	03/00	1017.9
	45006	47.3N	089.5W	0012	-0.3	3.4	0.6	1.2	01/10	9.5	NE	17.3	01/07	1018.5
	46001	56.3N	148.3W	0740	4.8	5.5	3.5	7.6	01/16	14.3	E	35.4	01/13	1003.4
	46002	42.5N	130.4W	0740	12.6	13.9	2.9	6.1	04/03	13.4	S	24.8	03/20	1024.3
	46003	51.9N	155.9W	0738	4.7	5.2	3.7	8.7	09/16	17.1	S	36.9	11/03	998.9
	46005	46.1N	131.0W	0738	11.3	12.2	3.0	8.2	03/05	13.6	S	31.4	03/00	1022.8
	46006	40.8N	137.7W	0731	13.7	14.2	3.1	8.4	03/00	16.3	S	36.1	02/15	1020.8
	46010	46.2N	124.2W	0736	8.5	10.0	2.1	5.9	04/06	11.2	E	35.0	04/05	1023.7
	46012	37.4N	122.7W	0737	12.9	13.7	1.9	4.2	03/18	8.7	N	20.9	29/09	1021.9
	46013	38.2N	123.3W	0739	11.2	12.9	1.8	4.7	28/23	8.3	NW	23.3	29/03	1021.3
	46014	39.2N	124.0W	0739	11.2	12.6	2.3	4.8	29/00	6.7	N	29.3	28/21	1021.7
	46022	40.8N	124.5W	0739	10.8	11.6	2.4	4.7	04/01	8.6	N	25.9	29/00	1022.6
	46023	34.3N	120.7W	0739	14.8	15.1	1.9	4.9	03/21	9.4	NW	26.8	06/02	1019.3
	46025	33.7N	119.1W	0739	16.2	16.9	1.0	2.4	04/02	5.8	NW	19.8	11/15	1019.4
	46026	37.8N	122.7W	0735	11.3	12.0	1.5	3.7	03/15	10.1	NE	22.9	22/16	1021.4
	46027	41.8N	124.4W	0717	10.1	10.7	2.2	4.8	03/11	9.0	N	26.4	29/00	1021.6
	46028	35.8N	121.9W	0740	14.0	14.6	1.9	4.1	29/10	6.5	NW	25.8	06/00	1020.3
	46030	40.4N	124.5W	0739	10.8	11.6	2.2	4.3	03/10	10.7	N	29.1	29/00	1021.9
	46035	57.0N	177.7W	0737	0.5	3.1	3.3	6.8	22/22	19.9	NE	35.9	01/12	1000.5
	46040	44.8N	124.3W	0737	9.4	10.8	2.3	5.9	04/08	9.6	SE	29.5	04/09	1024.1
	46041	47.4N	124.5W	0736	8.0	9.2	2.2	6.2	04/07	8.8	SE	27.8	04/04	1023.7
	46042	36.8N	122.4W	0738	12.9	14.0	2.1	4.3	03/17	7.5	E	23.9	29/10	1021.8
	51001	23.4N	162.3W	0741	22.7	24.9	2.7	5.0	01/13	11.3	N	24.0	13/12	1015.6
	51002	17.2N	157.8W	0739	25.1	26.3	2.3	3.9	26/06	11.8	E	30.3	31/14	1014.4
	51003	19.2N	160.8W	0734	24.4	25.9	2.5	4.7	01/17	10.9	NE	24.4	13/11	1014.5
	51004	17.5N	152.6W	0741	24.7	26.0	2.4	4.1	02/07	11.4	E	23.2	31/09	1014.0
C-MAN	ALSN6	40.5N	073.8W	0713	-2.9	6.4	0.8	2.1	16/06	17.5	NW	47.7	16/07	1017.9
	BURL1	28.9N	089.4W	0737	11.3					19.2	N	30.2	22/12	1019.7
	BUZM3	41.4N	071.0W	0736	-3.6					17.7	W	43.0	17/00	1015.6
	CARO3	43.3N	124.4W	0739	8.9					9.6	NE	32.2	05/01	1023.8
	CBLV2	36.9N	075.7W	0737	2.8	7.8	1.3	4.5	09/05	16.7	N	37.8	03/22	1019.3
	CLKN7	34.6N	076.5W	0738	5.0					13.3	N	36.9	24/06	1019.0
	CSBF1	29.7N	085.4W	0736	10.2					6.3	N	22.0	09/11	1021.0
	DBLN6	42.5N	079.4W	0733	-5.8					13.1	SW	36.2	26/16	1018.6
	DESN1	47.7N	124.5W	0738	7.6					9.8	SE	39.0	04/01	1023.5
	DISN3	47.1N	090.7W	0735	-10.0					14.0	W	36.5	14/17	1020.3
	DPIA1	30.3N	088.1W	0740	8.4	9.9				12.5	N	29.4	23/13	1021.6
	DSLN7	35.2N	075.3W	0732	7.9	15.7	2.2	10.7	24/21	20.2	N	59.0	24/16	1017.7
	ENIP2	11.4N	162.4E	0737	27.8					15.2	E	25.4	16/21	1010.0
	FARP2	8.6N	144.6E	0571	27.9					7.2	E	19.2	31/12	1009.5
	FBIS1	32.7N	079.9W	0738	6.1					9.1	NE	25.8	08/12	1019.8
	FFIA2	57.3N	133.6W	0738	4.6					13.8	N	37.1	20/02	1014.8
	FPSN7	33.5N	077.6W	0738	9.3					18.7	N	43.6	24/07	1018.9
	GBCL1	27.8N	093.1W	0739	15.0	22.2				16.2	NE	34.2	08/14	1020.8
	GDIL1	29.3N	090.0W	0734	9.6	12.4				12.1	N	38.0	23/11	1020.8
	GLLN5	43.9N	076.4W	0726	-8.9					13.7	NE	35.1	02/18	1018.3
	IOSN3	43.0N	070.6W	0738	-6.5					17.8	W	42.7	16/11	1015.0
	LKWF1	26.6N	080.0W	0734	17.8	23.3				7.9	NW	21.0	08/07	1018.8
	MDRM1	44.0N	068.1W	0738	-6.2					19.0	NW	45.1	16/14	1012.2
	MISM1	43.8N	068.9W	0739	-6.2					19.6	NW	44.1	03/06	1013.0
	MLRF1	25.0N	080.4W	0738	20.2	23.9				12.0	N	29.9	09/17	1019.1
	MPCL1	29.4N	088.6W	0684	12.7	18.9								1019.7
	NWPO3	44.6N	124.1W	0613	8.4					8.3	E	31.0	04/04	1024.7
	PILM4	48.2N	088.4W	0737	-11.3					13.6	NW	38.9	24/00	1019.3
	PTAC1	39.0N	123.7W	0739	9.5					5.2	N	27.8	29/00	1022.3
	PTAT2	27.8N	097.1W	0739	8.9	11.6				11.5	N	29.0	16/03	1021.9
	PTGC1	34.6N	120.7W	0740	14.5					7.7	N	34.6	06/18	1020.2
	ROAM4	47.9N	089.3W	0623	-9.9					17.3	N	43.3	24/01	1018.2
	SAUF1	29.9N	081.3W	0670	11.1	14.4				10.2	N	31.8	22/23	1020.6
	SBIO1	41.6N	082.8W	0707	-7.0					13.1	SW	36.2	03/05	1019.5
	SGNW3	43.8N	087.7W	0740	-9.2					12.1	W	33.3	26/01	1019.8
	SISW1	48.3N	122.8W	0737	6.8					7.0	SE	36.1	04/04	1024.5
	SMKF1	24.6N	081.1W	0290	18.6	22.0				12.2	N	28.3	23/21	1020.6
	SPGF1	26.7N	079.0W	0739	20.3	24.1				8.6	NW	35.8	24/09	1019.1
	SRST2	29.7N	094.1W	0738	7.2					9.3	N	23.0	22/08	1022.7
	STDM4	47.2N	087.2W	0738	-8.0					17.9	N	48.1	02/21	1017.4
	SVLS1	32.0N	080.7W	0739	7.9	11.9				14.6	N	31.4	03/13	1019.4
	TPLM2	38.9N	076.4W	0737	-2.3	9.6				11.5	NW	31.2	16/05	1019.4
	TTIW1	48.4N	124.7W	0738	7.6					12.3	E	47.1	04/04	1023.7
	UJAP2	8.9N	165.7E	0736	27.8					14.9	E	25.4	23/20	1009.0
	VENF1	27.1N	082.5W	0736	13.7	16.6				8.0	NE	26.2	09/14	1019.7
	WPOW1	47.7N	122.4W	0683	7.3					6.7	S	26.5	31/23	1024.2

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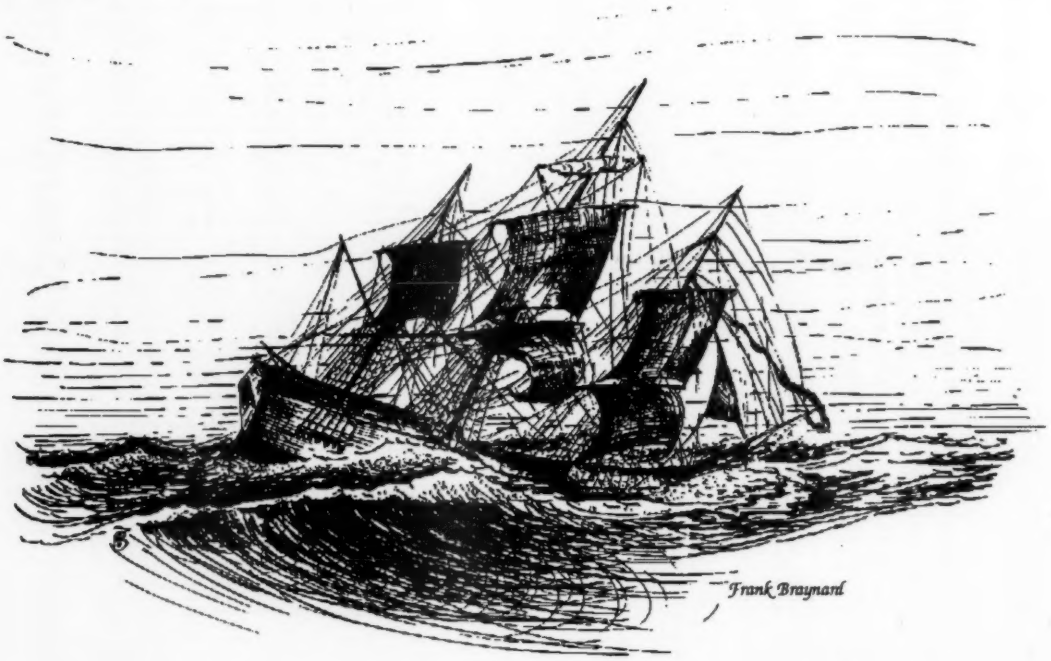

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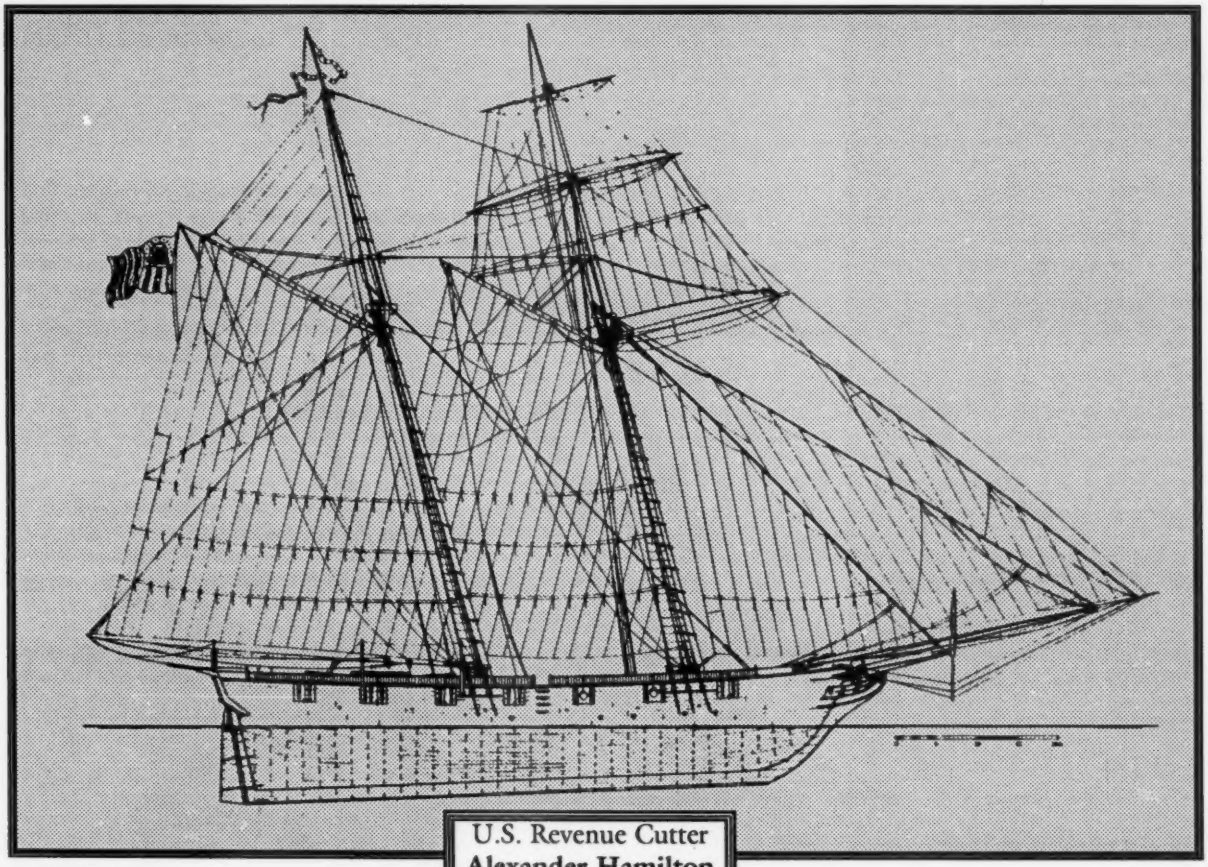

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